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WORLD OIL OUTLOOK

HEARING

BEFORE THE

COMMITTEE ON
ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE

ONE HUNDRED FIRST CONGRESS

SECOND SESSION

TO

ASSESS THE OUTLOOK FOR THE WORLD OIL MARKET IN THE 1990'S AND ITS IMPLICATIONS FOR U.S. ENERGY, ECONOMIC, AND SECURITY INTERESTS

MARCH 26, 1990

Printed for the use of the
Committee on Energy and Natural Resources

U.S. GOVERNMENT PRINTING OFFICE
29-786 WASHINGTON : 1990

For sale by the Superintendent of Documents, Congressional Sales Office
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S311-32

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WORLD OIL OUTLOOK

MONDAY, MARCH 26, 1990

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The committee met, pursuant to notice, at 9:35 a.m. in room SD-366, Dirksen Senate Office Building, Hon. J. Bennett Johnston, chairman, presiding.

OPENING STATEMENT OF HON. J. BENNETT JOHNSTON, U.S. SENATOR FROM LOUISIANA

The CHAIRMAN. The hearing will come to order.

Today's hearing is on the world oil outlook. The time is right for this hearing because oil has been in the news a lot lately. Unfortunately, the news I have seen in the first three months of 1990 has all been bad news.

In January, API reported that last year U.S. oil production dropped by over half a million barrels per day, by 7 percent. That same month the Energy Information Administration released its annual energy outlook for the period 1990 to 2010. That outlook is very troubling. EIA projects that domestic production will decline steadily and oil imports will grow enormously over the next 20 years. In fact, by 2010 we could be importing over two-thirds of our consumption.

February brought more bad news. The administration issued a study opposing a 1 billion barrel strategic petroleum reserve. The administration's position seems to be "don't worry, be happy, everything will be all right", despite the fact that the EIA projections indicate that a smaller 750 million barrel SPR has virtually no chance of providing a 90-day supply of oil imports in the future.

Finally, just last week I saw the trade deficit figures for January. Record imports of foreign oil pushed the trade deficit to over 9 billion dollars for that month. In January we imported 54 percent of our oil consumption. Obviously, this surge was related to the cold snap in December, but the January trade deficit is a harbinger of things to come. EIA projects that soon we will import 54 percent of our oil each and every month. In the foreseeable future, our oil import bill could triple from $50 billion to $160 billion.

If anyone can find a silver lining in these dark clouds, please tell me. We could all use some cheering up when it comes to oil.

I convened today's hearing to learn more about what the future holds for the world oil market. We have a distinguished panel of witnesses to help in this task. We want to get their opinions on a number of questions. I must tell our witnesses in this panel and the public at large, however, that I am extremely concerned about the trends. When we used to talk about the energy crisis, it meant a crisis in which somebody else would control our oil supply in which there would be a cutoff or a boycott, as they called it in those days. That is no longer the concern. The concern now, at least in my mind, is for the economy of the United States.

Our good staff has made some charts which I would commend to the public at large and particularly to those who are interested in oil. The first chart shows the trends in oil prices and GNP growth rate. The GNP growth rate tracks the trends in the oil price.

If you will get the next chart.

The next chart shows the trends in oil prices and inflation. Again, inflation and oil prices are almost in lockstep in terms of direction. I spoke to Art Laffer's group earlier last week and mentioned that there are a lot of people who want to take credit, including Art Laffer, who may be partially entitled to credit for the so-called recovery and strong economy. Also, I think Nancy Reagan's astrologer is taking credit for that. [Laughter.]

I think that if you look at the price for oil and what it does for inflation, what it does for GNP growth rate, what it does for inflation—next chart—and what it does to interest rates, you will think that this recovery is probably more related to the price of oil than it is to anything else. At least the price of oil is clearly a central economic factor as far as the country is concerned.

Now the last chart.

The next chart is on unemployment. Again, the trends are virtually in lockstep.

Finally, the trade deficit. About one-half of our trade deficit is now attributable to oil, I think in the neighborhood of $50 billion. We project it out by the year 2010 to be about $180 billion in 1990 dollars. If the price firms up as they want to say in the oil market or spurts up as others would say, then I think that what we have seen in these other trends about unemployment, interest rates and GNP growth is not very encouraging.

So I think it is time, Dr. Schlesinger, that we sound the klaxon, that we tell the country that we are in for a very rough time in terms of this economy, in terms of our competitiveness, and I hope that these charts will have set the scene for your testimony.

We are very pleased to have you back before this committee. You are a revered figure in energy as well as a lot of other endeavors, and we are glad to have you.

[The prepared statements of Senator Johnston and McClure follow:]

Opening Statement by Senator Johnston
Oversight Hearing on World Oil Outlook
March 26, 1990

Today's hearing is on the "World Oil Outlook". The time is ripe for this hearing because oil has been in the news a lot lately. Unfortunately, the news I have seen in the first three months of 1990 has been all bad news.

In January, the American Petroleum Institute reported that last year U.S. oil production dropped by over half a million barrels per day -- nearly 7 percent. That same month, the Energy Information Administration released its Annual Energy Outlook for 1990 to 2010. That "outlook" is very troubling. EIA projects that domestic production will decline steadily and oil imports will grow enormously over the next 20 years.

February brought more bad news. The Administration issued a study opposing a one billion barrel Strategic Petroleum Reserve. The Administration's position seems to be "Don't Worry, Be Happy", despite the fact that the EIA projections indicate that a smaller 750 million barrel SPR has virtually no chance of providing a ninety-day supply of oil imports in the future.

Finally, just last week, I saw the trade deficit figures for January. Record imports of foreign oil pushed the trade deficit to over nine billion dollars for that month. In January, we imported 54% of our oil consumption. Obviously, this surge was related to the cold snap in December, but January's trade deficit is a harbinger of things to come. EIA projects that soon we will import 54% or more of our oil each and every month. In the foreseeable future, our oil import bill could triple from 50 billion to 150 billion dollars.

If anyone can find a silver lining in these dark clouds, please tell me. I could use some cheering up.

I convened today's hearing to learn more about what the future holds for the world oil market. We have a distinguished panel of witnesses to help the Committee in this task. I want to know their opinions on a host of questions. The price and availability of oil carries wide implications for economic policy, energy policy, and national security.

THE LINKAGE BETWEEN OIL AND THE ECONOMY

I would like to focus attention at the outset on the strong linkages between the price and availability of oil and the health of the economy. Oil price spikes in 1973-1974 and again in 1979-1980 revealed how important a factor oil is in maintaining economic growth, stable prices, and employment.

The charts attached suggest the strength of the linkage between oil and the economy for the period 1970-1989. The first four charts show the change in oil prices over time and the corresponding changes in four key economic variables: GNP growth, inflation, unemployment rate, and interest rates.1/

The fifth chart shows a disturbing trend in the nation's payments for oil imports. The chart shows the actual and projected oil import bill (1970-2010) and the actual trade deficit (1970-1989; future projections not available). Both import bill and trade deficit are in billions of 1989 dollars. For many years oil imports have made up a substantial portion of the nation's trade deficit. However, projections by the Energy Information Administration on the future oil import bill show it more than tripling in real dollars by 2010.2/ This would constitute a huge hemorrhage of money flowing out of the country.

Today's trade deficit has proven difficult to close. We continue to consume more than we produce, and make up the difference by borrowing from the rest of world and by selling off our assets. Tomorrow's trade deficit will present an even more daunting problem, driven in large part by the oil import bill.

KEY ASPECTS OF THE WORLD OIL MARKET

The world oil market has certain features that are more or less permanent -- features that make it such a crucial commodity. First, oil supplies over 45% of all energy to the market economies of the world. The two oil crises of the 1970's wreaked havoc on those economies.

Second, most Western countries are, and will continue to be, dependent on large volumes of oil imports. Non-OPEC countries are generally producing oil at or near capacity and their remaining reserves are high cost reserves.

Finally, while OPEC's strength and unity has waxed and waned

1/ The variables are: real price of oil, the real growth rate in GNP, the change in the GNP deflator (inflation), the unemployment rate, and the 10-year nominal interest rate on Treasury bonds. The variables are indexed to a level of 100 in 1970.

2/ EIA's projection for the 2010 base case is $166 billion with a range of $141 to $180 billion. The range for this and other years is similarly narrow. In the low oil price scenario, prices are lower but imports are higher; in the high oil price scenario, prices are higher but imports are lower. The import bill is the product of price and quantity, and remains in a narrow range across the three scenarios.

over the years, its control over an enormous share of world reserves is an immutable geologic fact. The Middle East alone contains 70% of total free-world oil reserves including the overwhelming share of low-cost reserves. Many oil analysts believe OPEC may regain substantial market power in the coming decade.

In short, the market economies of the world remain very vulnerable to both disruptions in oil supplies and concerted actions by OPEC.

RECENT DEVELOPMENTS AFFECTING THE WORLD OIL MARKET

The recent dramatic events in the Soviet Union and Eastern Europe may have substantial effects on the world oil market. The Soviet Union's oil reserves are greater than any country's other than Saudi Arabia and Kuwait. Currently the world's largest oil producer, the Soviet Union produced an average of 12.1 million barrels a day in 1989. However, oil production has been declining, with an estimated drop in output of approximately 350,000 barrels per day in 1989. Experts anticipate a similar, or greater, decline in 1990, with some predicting that production could slide to 10 million barrels per day by 1995.

Declining production has been attributed to the maturing of Soviet oil fields and high production costs relative to today's petroleum prices. Soviet technology is outdated, and production practices have emphasized maximizing short-term production rather than optimizing long-term field production.

Some experts see declining Soviet production as having only a slight impact on global petroleum markets, with the drop likely to be made up by increased production by the Organization of Petroleum Exporting Countries. However, concern has been expressed over the almost complete dependence of East European countries on Soviet energy exports. According to one expert, Soviet oil and gas exports currently supply roughly 25 percent of East European energy needs. In 1987, Soviet oil deliveries to Eastern Europe constituted the following estimated percentages of total oil consumption in these specific countries: Bulgaria - 88%; Czechoslovakia - 99%; East Germany - 100%; Hungary - 99%; and Poland 93%.

The impact that declining Soviet production and East European dependency on Soviet energy might have on world energy markets is just beginning to be explored. Issues that need to be addressed include the following: (1) the impact on world oil markets if East European countries that had previously purchased a large share of their oil needs from the Soviet Union instead purchase from OPEC producers; (2) the ability of these countries to finance such purchases, particularly in light of the fact that the Soviets had subsidized oil supplied to Eastern Europe; (3)

the ability/willingness of the Soviet Union to continue to fulfill East European energy needs; and (4) the impact on United States markets of declining Soviet production and increased OPEC exports to Eastern Europe.

Other recent developments likely to have a profound impact on the world oil market involve environmental policies at the national and international level. A comprehensive set of Clean Air Act amendments will likely become law sometime this year. One potential effect of this legislation is to dramatically increase the demand for natural gas (e.g., as a means of reducing sulphur dioxide emissions, as a feedstock for methanol, and as a direct vehicle fuel.) Oil and gas markets have strong links. An increase in demand for one is felt in both markets.

At the international level, concerns are rising over global climate change. Pressures for reducing carbon dioxide emissions may reduce the demand for coal and increase the demand for natural gas (with an indirect effect on the oil market) or for oil directly (having lower CO2 emissions than coal).

These and other developments should be addressed in the hearing.

Chart 1

TRENDS IN OIL PRICES AND GNP GROWTH

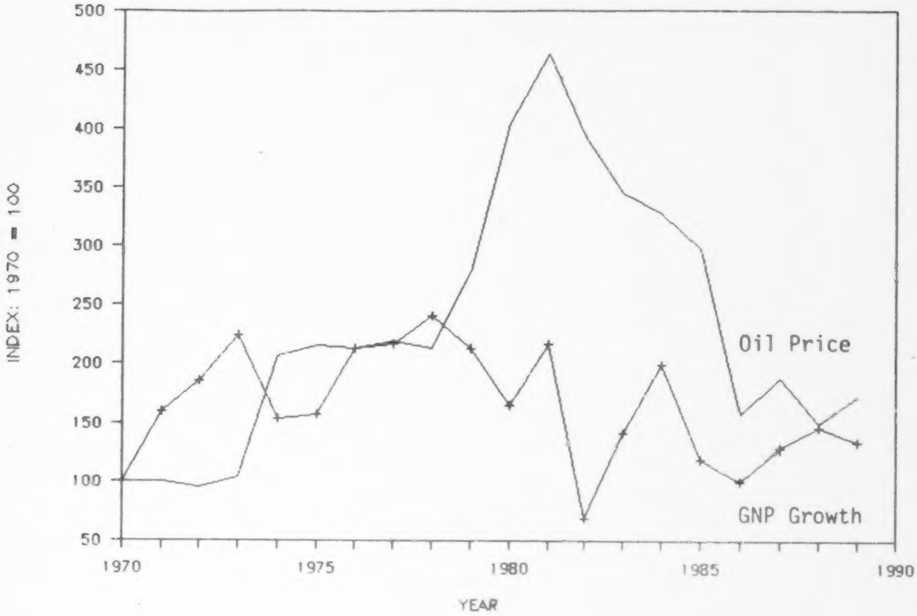


Chart 2

TRENDS IN OIL PRICES AND INFLATION

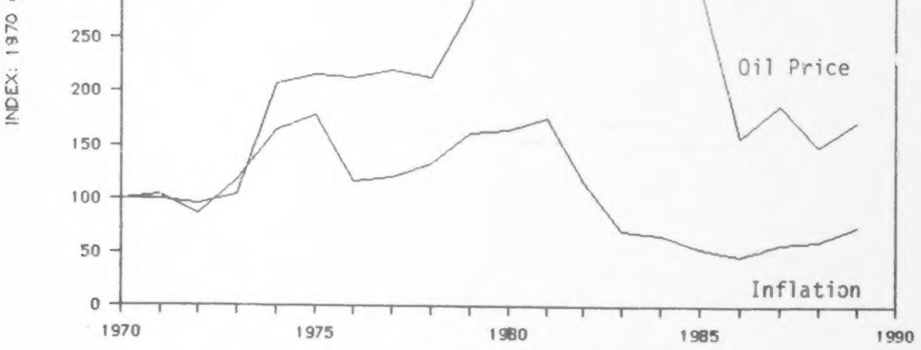


Chart 3

TRENDS IN OIL PRICE AND INTEREST RATES

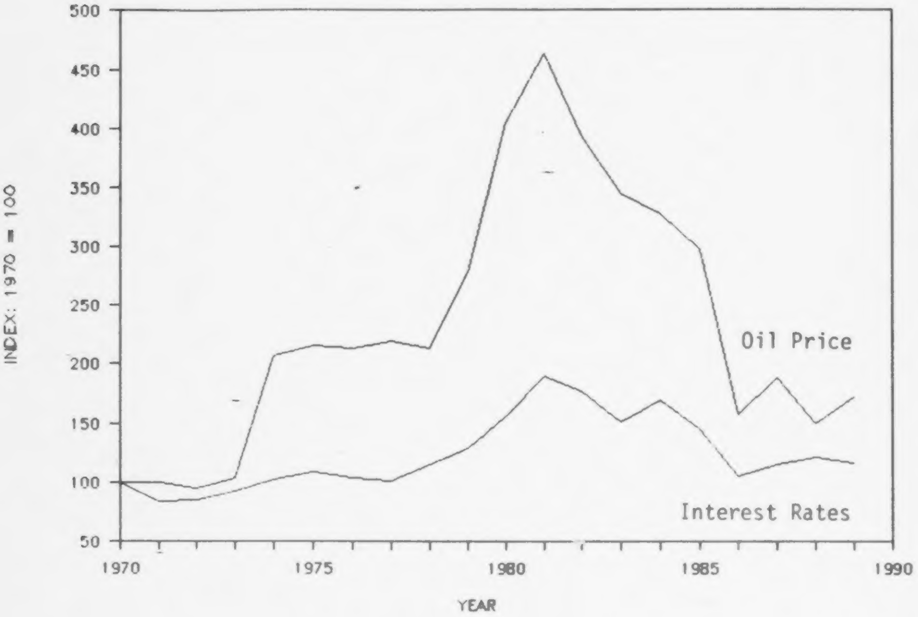


Chart 4

TRENDS IN OIL PRICES AND UNEMPLOYMENT

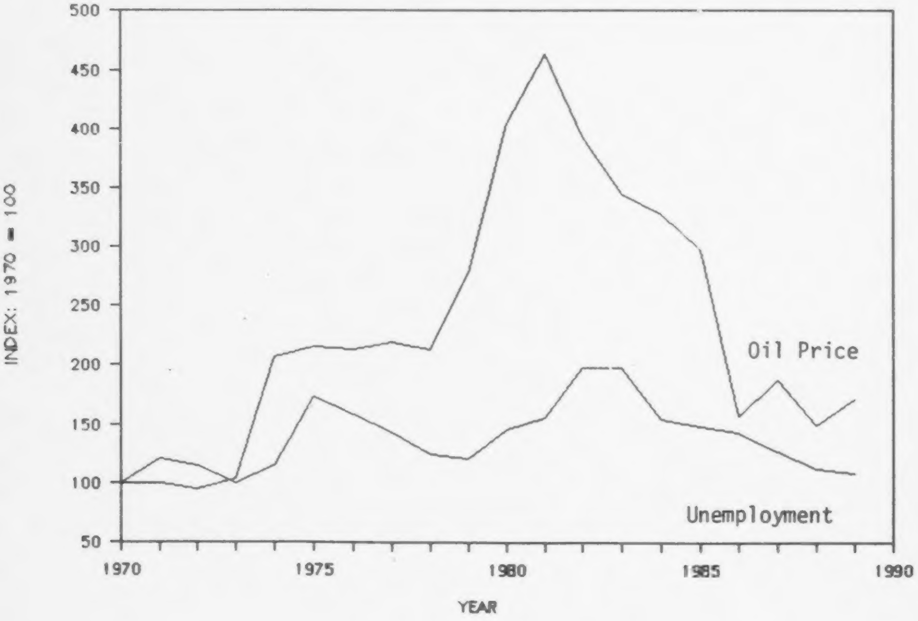
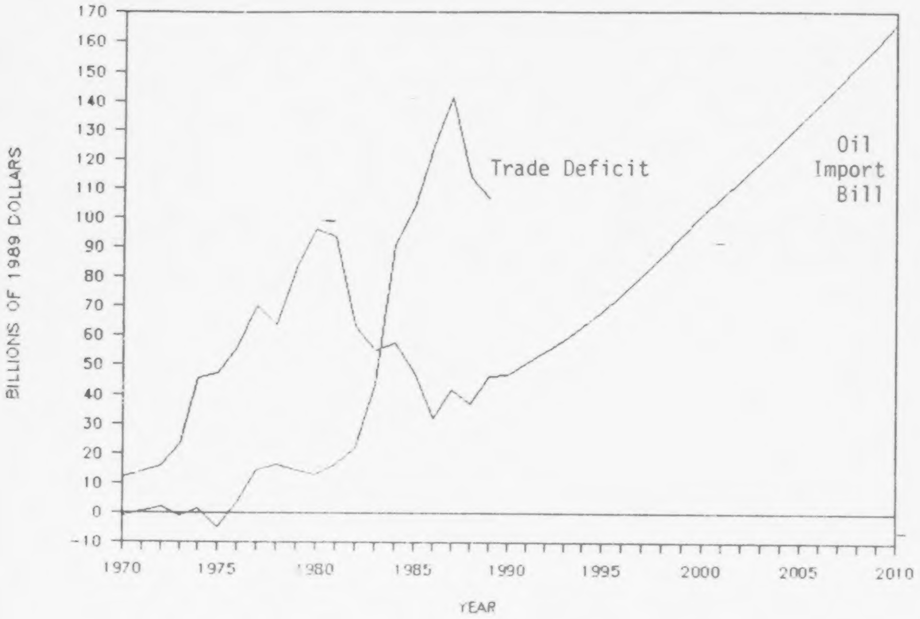


Chart 5

TRENDS IN TRADE DEFICIT AND OIL IMPORT BILL



Statement Of
Senator James A. McClure (R-ID)

Committee on Energy and Natural Resources
Oversight Hearing On

The Outlook for the World Oil Market in the 1990's
March 26, 1990

I am pleased that the Committee is holding this oversight hearing on the world oil situation; but it reminds me of that old saying about the weather: While everyone talks about it, no one does anything about it!

What we will hear today, just as we heard a few days ago at the Committee's hearing on the future of the Strategic Petroleum Reserve, can be boiled down to a few basic "facts": One, U.S. energy consumption will grow over the next decade; two, domestic oil production will continue to decline; three, our foreign oil dependency will increase; four, there is some likelihood that there will be a significant supply disruption before the 1990's are over; and five, if there is a disruption, it will have severe consequences on our economy and society.

There is no dispute about these "facts"; the only question is what, if anything, we are going to do to change them.

There are some who believe that the marketplace can take care of any problems which might arise, regardless of magnitude, and therefore we do not need to do anything. While I strongly believe in the free market, having lived through the 1973 Arab oil embargo and the 1979 disruption brought about by the Iraq/Iran war, it is clear to me that there are situations which the marketplace can not handle without undue and unacceptable consequences.

Unless we develop and implement a comprehensive energy strategy, it is without question that at some point in the not too distant future, we will once again wake up and find ourselves "shocked" that some foreign producer was not able to -- or was not willing to -- provide us with unlimited quantities of cheap energy. That again, to our great "surprise," they have put their interests first, not ours; that they have again employed the "oil weapon" for their political or economic gain without concern for the impact on our economy. And that once again we will suffer through another decade of counterproductive so-called "energy policies," hastily created in the heat of the moment to satisfy political imperatives.

All of this is avoidable -- if, and only if, we commit ourselves to avoiding it.

Thus, I am encouraged that the President, through the Secretary of Energy, is committed to the development of a comprehensive, long-term national energy strategy, and I look forward to reviewing it when it is released later this year. What is at stake in these efforts is not merely our future energy supply, it is also our economy, our foreign policy, and our national defense.

We must meet the challenge, since the alternative is simply not acceptable. Clearly, we must plan now and take action now if we want to protect the energy and economic future of our Nation. And if we don't act, we will only have ourselves to blame.

STATEMENT OF HON. JAMES R. SCHLESINGER

Dr. **Schlesinger**. Thank you, Mr. Chairman.

The **Chairman**. Dr. Schlesinger, by the way, is on the board of advisers of Sheikh Zaki Ahmed Yamani Center for Global Energy Studies in London in addition to his other accolades.

Senator **Ford**. The reason he said that is he wanted everybody to know he could pronounce it. [Laughter.]

Dr. **Schlesinger**. He did very well.

Senator **Ford**. He did very well.

Dr. **Schlesinger**. Thank you, Mr. Chairman and Senator Ford. It is a special honor and a delight for me to serve as your leadoff witness as the committee revives after a three-year hiatus its survey of the world energy scene. The committee will find the landscape radically and perhaps astonishingly altered. Three years ago OPEC appeared to be on the ropes with its members struggling with one another for individual shares of substantially reduced OPEC production.

Adding to the pressure was the then straightened financial circumstances among the exporting nations. Prices were precarious and had previously dropped to as low as $8 per barrel in the Gulf. Here in the United States producers were disheartened, the essential collapse of domestic drilling activity had already taken place, producers were fearful that at any moment prices might plummet again, and acted accordingly. All were shrinking their operations, and many had either left or expected to leave the business.

In the mood of those times it required a certain temerity to say, as I did, that one should not be misled by the glut which was transitory, that OPEC fortunes would revive as the world became more dependent upon the Gulf, and that the rapid growth in U.S. oil dependency would adversely affect our national security interests.

Mr. Chairman, we have been jointly playing the role of Cassandra for many years. Finally it seems to be coming around.

At that time there was a widespread tendency to believe that even if the glut would not last forever, low oil prices would continue to prevail through the end of the century. Energy had become a nonproblem. Today the landscape is radically altered. OPEC has been producing in excess of 23 million barrels per day and recently has been close to 24 million barrels per day. To everyone's surprise, including those in the industry, the market has been absorbing this level of production. The market has been astonishingly buoyant.

Prices which had been expected to go well below $20 per barrel, West Texas Intermediate, in the first quarter, given this level of production, have remained above $20 per barrel until just this last week. Almost all of OPEC's members have been producing all out.

In the aggregate, OPEC has been producing at very close to capacity levels. The quota system which has been honored only in the breach has now become largely irrelevant. As opposed to battling over shares of a shrinking market, OPEC is now in the happy position of allocating growing shares in an expanding market. Pressures upon and within OPEC have been substantially alleviated. Indeed, control over the market is once again within the grasp of those major producers in the Gulf that have excess or expandable capacity.

Meanwhile, U.S. production has fallen and continues to sink. Drilling activity remains low. The long anticipated decline of the Prudhoe Bay field has now set in with a vengeance. Growing domestic demand along with declining production has raised U.S. imports by 3.5 million barrels per day. Increased U.S. imports have counted for more than half of the growth of OPEC exports.

Irrespective of our declamations, Mr. Chairman, the United States has proved to be OPEC's truest friend in its hour of need. The United States has been the principal engine in the restoration of OPEC's power.

In some recent months our import dependency has exceeded 50 percent, and the prospects for the future scarcely permit one to be sanguine. In 1995 U.S. imports should reach 10 to 11 millions barrels per day. The cost of oil imports will have more than tripled from the low point. Indeed, the oil import bill then will likely exceed our present trade deficit.

Mr. Chairman, if there is a single issue in this dramatic turnaround that I should like to highlight for the members of this committee, it is the realities about capacity. Mr. Chairman, we face a situation not dissimilar from that existing at the end of the 1960s and the beginning of the 1970s when rising world oil demand had begun to encroach upon available capacity. The stage was being set for oil price increases, though not necessarily as severe as those in the oil price shocks of the 1970s.

OPEC has recently been operating in excess of 90 percent of sustainable capacity, though the call on OPEC in terms of consumption is somewhat less. The published figures on capacity including those of the Central Intelligence Agency have regularly overstated sustainable capacity.

Typically and understandably, OPEC members have exaggerated their available capacities in the quest for larger quotas. Many of the members of the organization have been unable to produce enough to reach their quota levels. OPEC's sustainable capacity today is a little in excess of 25 million barrels per day. With the call on OPEC growing at over 1 million barrels per day each year, we are only a couple of years away from the point that the demand will theoretically reach the level of present capacity.

Just a year ago there was concern within the industry as to how the market might absorb additional production from Iran and Iraq as the war came to an end. It has now become evident that that particular concern was misplaced, and the consequences of war, of neglect and of mismanagement suggests that the two former belligerents can provide only 6 million barrels per day to the market at this time.

Developments outside OPEC add to the problem. Most significantly, oil production in the Soviet Union has fallen from 12.6 million barrels per day to less than 12 million barrels per day, and Soviet difficulties appear to be growing. A further decline by the middle 1990s to roughly 10 million barrels per day appears likely. Even with internal conservation, that would add 1 to 1.5 million barrels per day to the call on OPEC.

As a consequence of developments both within and outside of OPEC, the day in which we face capacity constraints has come that much closer. Members of OPEC or at least the more responsible ones are concerned that we not hit the capacity ceiling and not have a price spike those of 1973–74 and 1979–80.

Consequently, both the Saudis and the Kuwaitis are adding to capacity in a way that will cushion that prospective blow. In the years ahead the Saudis hope to have expanded capacity to 8.5 million barrels per day and the Kuwaitis to 3.2 million barrels per day. Given the altered structure of energy markets, there is substantial difficulty in raising the capital necessary for further expansion. The actions of Kuwait and Saudi Arabia may postpone until the middle of the decade the point at which we theoretically hit the capacity ceiling. Unless additional measures and countermeasures are taken in the years immediately ahead, we face the potential of another price spike.

At the moment, however, our actions are more likely to reinforce those tendencies. Take, for example, the issue of electric power generation. Nuclear power in this country and elsewhere is moribund. New coal-fired capacity is inhibited by concerns about global warming, environmental policy and an understandable bias amongst utilities against baseload capacity.

Thus, in the last year some 70 percent of new capacity ordered has been combustion turbines or combined cycle. We are turning back to hydrocarbons to provide generating capacity, but that will simply add to the pressure on prices and on our import bill.

Mr. Chairman, I close with a few observations about national security. Each month we are becoming more dependent on external sources of supply and increasingly dependent upon the volatile Persian Gulf. Drilling activity continues to be low. The infrastructure that previously sustained domestic exploration and production has been sharply reduced in the past half decade. Dependency will continue to grow, although the pace can still be affected by our policy decisions. According to present trends, by the middle 1990s we shall be roughly 65 percent dependent on foreign sources of supply.

Mr. Chairman, I hesitate to be more pessimistic than your opening statement, but I believe that that statement postponed the two-thirds dependency into the 21st Century. I think we can get there sooner and probably will.

Meanwhile, the strategic petroleum reserve, our chief surviving element of protection against a cutoff, will have shrunk in real terms from roughly 100 days of import to 60 days of imports. Do we really care? To be sure, the worst possible threat, that of Soviet domination of the oil tap in the Middle East, seems to have receded at least for the moment; but the Persian Gulf remains a potentially explosive region.

Just recently the United States with the Soviet Union as a de facto ally was attempting to contain the damage of the tanker war in the Gulf. Even without external intervention, the Gulf remains a worrisome and questionable source of supply, and the possibility of outside meddling at some future date should not be forgotten.

If, however, we are to alter present trends, we must start soon. Time is beginning to run out. The damage that has already occurred is far greater than is generally realized. We may as well acknowledge that over the past decade the United States as a practical matter abandoned the quest for energy independence, indeed even the quest for low energy dependency. If we are to limit our future vulnerability either for national security or international financial reasons, we shall have to reverse course and take vigorous action.

Mr. Chairman, I thank the committee for its attention. I shall be happy to answer any questions.

[The prepared statement of Dr. Schlesinger and map submitted by Senator Domenici follow:]

STATEMENT BY
JAMES R. SCHLESINGER
before the
COMMITTEE ON ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE

March 26, 1990

Mr. Chairman, Members of the Committee:

It is a special honor and a delight for me to serve as your lead-off witness, as the Committee revives -- after a three year hiatus -- its survey of the world energy scene. The Committee will find the landscape radically and perhaps astonishingly altered. Three years ago OPEC appeared to be on the ropes -- with its members struggling with one another for individual shares of substantially reduced OPEC production. Adding to the pressure was the then straitened financial circumstances among the exporting nations. Prices were precarious, and had previously dropped to as low as $8.00 per barrel. Here in the United States producers were disheartened. The essential collapse of domestic drilling activity had already taken place. Producers were fearful that at any moment prices might plummet again -- and acted accordingly. All were shrinking their operations, and many had either left or expected to leave the business.

In the mood of those times, it required a certain temerity to say, as I did, that one should not be misled by the glut, which was transitory, that OPEC fortunes would revive as the world became more dependent upon the Gulf, and that the rapid growth in U.S. oil dependency would adversely affect our national security interest. But at that time their was a widespread tendency to believe that, even if the glut would not last forever, low prices would continue to prevail through the end of the century. Energy had become a non-problem.

Today the landscape is radically altered. OPEC has been producing in excess of 23 million barrels per day, and recently has been close to 24 million barrels. To everyone's surprise, including those in the industry, the market has been absorbing this level of production. The market has been astonishingly buoyant. Prices, which had been expected to go well below $20 per barrel in the first quarter (given this level of production), have remained above $20 per barrel until just this last week. Almost all of OPEC's members have been producing all out. In the aggregate OPEC has been producing very close to capacity levels. The quota system, which has been honored only in the breach, has become largely irrelevant.

As opposed to battling over shares of a shrinking market, OPEC is now in the happy position of allocating growing shares in an expanding market. Pressures upon and within OPEC have been substantially alleviated. Indeed, control over the market is once again within the grasp of those major producers in the Gulf that have excess and or expandable capacity.

Meanwhile, U.S. production has fallen -- and continues to sink. Drilling activity remains low. The long-anticipated decline of the Prudhoe Bay field has now set in with a vengeance. Growing domestic demand along with declining production has raised US imports by three and a half million barrels per day. Increased U.S. imports have counted for more than half of the growth of OPEC exports. Irrespective of our declamations, the United States has proved to be OPEC's truest friend in its hour of need. The United States has been the principal engine in the restoration of OPEC's power.

In some recent months our import dependency has exceeded fifty percent, and the prospects for the future scarcely permit one to be sanguine. In 1995 US imports should reach ten to eleven million barrels a day. The cost of oil imports will have more than tripled from the low point. Indeed, the oil import bill then will likely exceed our present trade deficit.

Mr. Chairman, if there is a single issue in this dramatic turn around that I should like to highlight for the Members of the Committee, it is the realities about capacity. Mr. Chairman, we face a situation not dissimiliar from that existing at the end of the 60s and the beginning of the 70s, when rising world demand had begun to encroach upon available capacity. The stage was being set for oil price increases -- though not necessarily as severe as those in the oil price shocks of the seventies.

OPEC has recently been operating in excess of 90 percent of sustainable capacity (though the call on OPEC in terms of consumption is somewhat less). The published figures on capacity, including those of the Central Intelligence Agency, have regularly overstated sustainable capacity. Typically (and understandably) OPEC members have exaggerated their available capacities in the quest for larger quotas. Many of the members of the organization have been unable to produce enough to reach their quotas. OPEC's sustainable capacity today is little in excess of 25 million barrels per day. With the call on OPEC growing at over a million barrels per day each year, we are only a couple of years away from the point that demand would theoretically reach the level of present capacity.

Just a year ago there was concern within the industry as to how the market might absorb additional production from Iran and Iraq, as the war came to an end. It has now become evident that that particular concern was misplaced, and the consequences of war, of neglect, and of mismanagement suggest that the two former belligerents can provide only six million barrels per day to the market.

Developments outside OPEC add to the problem. Most significantly, oil production in the Soviet Union has fallen from 12.6 million barrels per day to 12 million barrels per day. And Soviet difficulties appear to be growing. A further decline by the middle 90s to roughly 10 million barrels per day appears likely. Even with internal convservation that would add one to 1.5 million barrels per day to the call on OPEC.

As a consequence of developments both within and outside of OPEC, the day in which we face capacity ordered constraints has come that much closer.

Members of OPEC -- or at least the more responsible ones -- are concerned that we not hit the capacity ceiling and not have a price spike like those of 73-74 and 79-80. Consequently both the Saudis and the Kuwaits are adding to capacity -- in a way that will cushion the prospective blow. In the years ahead the Saudis hope to have expanded capacity to 8.5 million barrels per day and the Kuwaits to 3.2 million. But given the altered structure of energy markets, there is substantial difficulty in raising the capital necessary for further expansion. The actions of Kuwait and Saudi Arabia may postpone until the middle of the decade the point at which we theoretically hit the capacity ceiling. Unless additional measures and countermeasures are taken in the years immediately ahead, we face the potential of another price spike.

At the moment, however, our actions are more likely to reenforce these tendencies. Take, for example, the issue of electric power generation. Nuclear power in this country (and elsewhere) is moribund. New coal-fired capacity is inhibited by concerns about global warming, environmental policy, and an understandable bias among utilities against base-load capacity. Thus, in the last year some seventy percent of new capacity has been combustion turbines or combined cycle. We are turning back to hydrocarbons to provide generating capacity. But that will simply add to the pressure on prices and our import bill.

Mr. Chairman, I close with a few observations about national security. Each month we are becoming more dependent on external sources of supply -- and increasingly dependent upon the volatile Persian Gulf. Drilling activity continues to be low. The infrastructure that previously sustained domestic exploration and production has been sharply reduced in the past half decade.

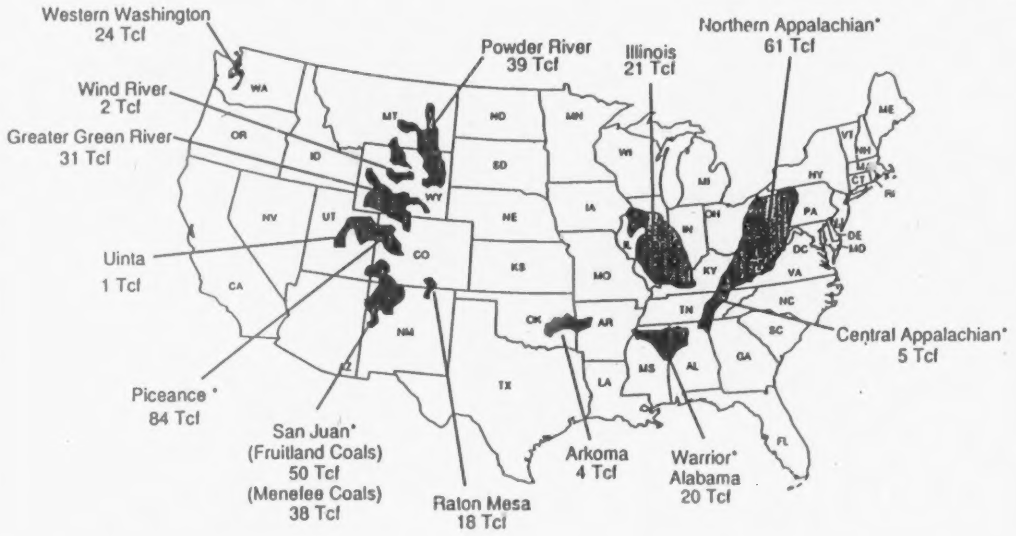
Dependency will continue to grow, although the pace can still be affected by our policy decisions. According to present trends by the middle 1990s we shall be roughly 65 percent dependent on foreign sources of supply. Meanwhile the Strategic Petroleum Reserve (our chief surviving element of protection against a cutoff) will have shrunk in real terms from roughly 100 days of imports to 60 days of imports.

Do we really care? To be sure, the worst possible threat, that of Soviet domination of the oil tap in the Middle East, seems to have receded -- at least for the moment. But the Persian Gulf remains a potentially explosive region. Just recently the United States (with the Soviet Union as a de facto ally) was attempting to contain the damage of the Tanker War in the Gulf. Even without external intervention, the Gulf remains a worrisome and questionable source of supply. And the possibility of outside meddling at some future date should not be forgotten.

If, however, we are to alter present trends, we must start soon. Time is beginning to run out. The damage that has already occurred is far greater than is generally recognized. We may as well acknowledge that over the past decade the United States, as a practical matter, abandoned the quest for energy independence -- indeed, even the quest for low energy dependency. If we are to limit our future vulnerability, either for national security or international financial reasons, we shall have to reverse course -- and take vigorous action.

Mr. Chairman, I thank the Committee for its attention. I shall be happy to answer any questions.

Coalbed Methane Resources of the U.S.


Western Washington
24 Tcf
Wind River
2 Tcf
Greater Green River
31 Tcf
Uinta
1 Tcf
Piceance *
84 Tcf
San Juan*
(Fruitland Coals)
50 Tcf
(Menefee Coals)
38 Tcf
Raton Mesa
18 Tcf
Powder River
39 Tcf
Illinois
21 Tcf
Northern Appalachian*
61 Tcf
Central Appalachian*
5 Tcf
Arkoma
4 Tcf
Warrior*
Alabama
20 Tcf

*Detailed Geologic Appraisals Completed by GRI/ICF-Lewin

Total Resource ≃ 400 Tcf

ICF Resources Incorporated

1.

The **Chairman**. Thank you, Dr. Schlesinger. Our projection of two-thirds dependency by the year 2010 was an EIA worst case projection. Would you tell us why you think they are unduly optimistic?

Dr. **Schlesinger**. Well, let me discuss—the present situation is that we are importing over 8 million barrels a day, total imports at the present time. Production in the lower 48 States has been dropping at 6 percent per annum.

The **Chairman**. I think 7 percent last year.

Dr. **Schlesinger**. Is it? It seems to be on roughly a 6 percent declining curve. At Prudhoe Bay the decline has finally set in, as I said, with a vengeance, and the decline curve at Prudhoe Bay appears to be 10 to 13 percent. We have used up much of the oil in Prudhoe Bay itself. We are not exploring elsewhere in Alaska at this time.

That means that we are going to see the oil production in the United States dropping somewhere between 400,000 and 500,000 barrels a day each year. By the middle 1990s we will have domestic oil production down in the range of 5.3, 5.4 million barrels a day. Throw in LNG you're up to about 7 million barrels a day of domestically produced hydrocarbon supply.

In recent years, demand has grown. It slowed down somewhat last year, but I think that one can say that domestic demand will continue to grow until there are sharp price increases by about 2 percent per annum.

That is about 300,000, 350,000 barrels a day each year, a growth of oil imports of three-quarters of a million barrels a day, perhaps a little less, but you just cumulate that for five years, and in the middle 1990s we are importing something on the order of 11 million barrels a day and we are producing from domestic supply, once again, about 7 million.

If one examines the numbers one ends up at about the two-thirds level. Last month we passed 54 percent. Admittedly, it was an odd month, but if you just examined the trends, it is very hard to say that it will take until well into the next century to get to two-thirds dependency.

The **Chairman**. Well, Dr. Schlesinger, that statement, if correct, is of the profoundest concern for this country and its economy.

You also say that by 1995 the oil deficit should exceed the rest of the trade deficit.

Dr. **Schlesinger**. Yes, sir.

The **Chairman**. Now, that is based on what price of oil?

Dr. **Schlesinger**. Something on the order of $30 a barrel. 10 million barrels a day, that is 3.65 billion barrels a year multiplied by 30, we are up at about 110.

The **Chairman**. Is that $30 in nominal prices, or in 1990 dollars?

Dr. **Schlesinger**. For this purpose I'm only using nominal prices, but I believe that you are likely to see oil prices rise something in that range in real terms.

The **Chairman**. So that it would be even more marked than if you had a price spike?

Dr. **Schlesinger**. Yes, sir. Oh, yes indeed.

The **Chairman**. You are not taking into consideration any price spike, you are just using today's nominal price?

Dr. **Schlesinger**. I think that you're going to have a steady upward drift of real prices starting probably—well, it has been going on for some years. It will continue in the years immediately ahead and then begin to accelerate as we reach capacity limits.

The **Chairman**. Now, Dr. Schlesinger, you say that most of the producers in the Gulf are already at capacity. Only, I think Saudi Arabia and maybe Kuwait are less than capacity?

Dr. **Schlesinger**. Kuwait has been following a practice that when the price of oil gets over the reference price it produces all-out. As a practical matter, only the Saudis now have excess capacity. The other producers have either been producing above quota all-out, or attempting to reach quota and producing all-out, so that there is very little excess capacity left.

The **Chairman**. Now, the Saudis are what, about 2 million barrels a day away from capacity?

Dr. **Schlesinger**. It is about 1.5 million at the present time, perhaps a little less.

The **Chairman**. Now, they are adding capacity. When does that capacity come on line?

Dr. **Schlesinger**. That has been coming on line slowly. By the end of this year they hope to be at 7.5 million a day. By the 1992 they hope to be, as I said in my paper, at 8.5. There is skepticism within the industry that they can get that far that soon.

The **Chairman**. I was intrigued by your statement that there is a capital dearth in Saudi Arabia?

Dr. **Schlesinger**. I think that my statement, there is a general problem of capital shortage, and you have to separate it out very carefully. For example, I start with the easiest case, Iran. Iran would like to attract foreign capital. Iran's oil problems are very severe, flowing from things that we have discussed earlier, ten years ago, but Iran is unable to attract foreign capital. There is severe difficulty. Iraq is overly indebted.

The Kuwaitis and Saudis have less need for foreign capital. To a greater extent they can expand production somewhat out of cash flow, but there is a plan in Saudi Arabia to go to 10 million barrels a day, and that has been estimated to require $30 billion of capital.

The interesting thing is that at price levels of $17 or $16 or $18 a barrel, they do not generate from internal cash flow enough to expand to that 10 million, so even the Saudis have capital constraints. There is a fundamental problem.

They have turned to the outside world. It has been advocated, for example, that the international oil companies come in and provide that capital, but the oil companies have taken the attitude that they are not going to do it on a service fee basis of 30 cents a barrel. If you want us to come in, it is going to have to be on an equity basis.

The producers in the Middle East have turned to the source of all capital on this planet now, the Empire of Japan, and the Japanese take the same attitude, which is that we are not going to provide that kind of capital on a service fee basis, that it has to be on an equity basis.

So my statement had hidden within it the problem of attracting capital when one is operating companies on a service fee basis.

There is no inherent problem of attracting capital if there is a willingness to provide equity shares.

The **Chairman**. Now, you described a situation where consumption is going up, demands on OPEC at about a million barrels per day per year——

Dr. **Schlesinger**. More than that.

The **Chairman**. And that the Saudis and Kuwaitis are adding production.

Dr. **Schlesinger**. Yes.

The **Chairman**. Now, which line gets there first?

Dr. **Schlesinger**. At the moment, capacity is a little ahead of demand and it is staying a little ahead of demand. I should throw in Iraq. Iraq will probably be able, over the next half decade, to increase supply capacity by half a million barrels if it can attract foreign capital, which is still a question, but by the middle of the decade there is no question that we will have absorbed existing capacity. We hit that capacity ceiling, prices are forced up by market forces. It may come earlier.

We have Eastern Europe. What is happening in Eastern Europe? In the good old days of the Soviet imperium, the regimes in Eastern Europe held down consumption by brute force as Mr. Coucescu did. He kept room temperatures in Romania at 58 degrees. In this new post-liberation world, temperatures in Romania are not going to stay at 58 degrees.

East Germany will clearly use much more oil than it has. I think Czechoslovakia and Hungary will, too. You see those consequences plus the decline of production in the U.S. and the Soviet Union, and we may hit capacity limits earlier than the middle of the decade—1992, 1993.

The **Chairman**. So that, in effect, by '92 or '93 control of oil prices will no longer be subject to market forces. They will be, at least by that time, in the control of the Saudis and the swing producers, and perhaps they will be beyond the control of the Saudis and the swing producers and in the hands of the so-called militants in OPEC?

Dr. **Schlesinger**. Right, or in the hands of market forces. If demand exceeds supply there is only one thing that happens to price. It goes up.

The **Chairman**. What would be your guess as to the percentage probability of a strong price spike by the middle of the decade?

Dr. **Schlesinger**. I think that we are going to see a price surge. A price spike means that in a year or 18 months you see prices going up 60 percent. I think that there is a strong probability of perhaps 30 or 40 percent. I hope that we can reduce it by our own policies, but that we will have a price surge in the decade seems to me beyond question, Mr. Chairman.

The **Chairman**. Now, Dr. Schlesinger, there are many who say that this country could solve its problems if we would move toward renewable energy in a concerted and strong way and fund it properly and support it by the government. Do you think that can solve our problems? What is the place of renewable energy?

Dr. **Schlesinger**. Renewable will not solve our problem. Indeed, the renewables work with something else, in effect, and that is electric power supply. It may ease the growth of demand for oil and natural gas in the generating industry, but that is all that it does.

The surge that we see is taking place in basically in transportation. That is the chief source of increase in oil demand, and renewable is not going to substitute in any serious way for demand for oil in transportation. There is no way that that can be done. There have been improvements in solar powered cars, but when one looks at those things, one discovers that the payload of those automobiles is just not what will satisfy the American consumer.

The CHAIRMAN. What should we be doing in this country.

Dr. SCHLESINGER. What should we be doing? We know what to do, Mr. Chairman. We have always known what to do, which is that we should conserve on the domestic use of oil, that we should provide more tax benefits for—strike that word, tax benefits. It does not sound right—better tax incentives for domestic producers, that we should be drilling in those places that we think oil can be found.

So we conserve on domestic use of oil and we add to domestic production. That will not solve our problems, but it will postpone them.

The CHAIRMAN. Well, what do you say to those who say that we should not be drilling in California and Alaska, that if there is oil there it will still be there, that we ought to hold that back as a strategic reserve, in effect?

Dr. SCHLESINGER. Well, I think there is, if I may say so, a note of disingenuousness in that particular line of argument, because it by and large comes from people who do not want it ever to be drilled, not until judgment day. They want it to be there for all eternity, as it were.

But to that argument, one must look at this in terms of the responsibilities placed upon the Government of the United States, the Executive and the Legislature, to deal with our problems in the next 15 years.

The problems that we have are national security problems. Despite the decline of Soviet power the United States still stands forth as the great, global, stabilizing power, and if we are dependent upon—as we grow more dependent upon foreign sources of supply, our position is weakened.

Our position is challenged as the leading economy in the world by a severe trade deficit and current account deficit which has forced us to permanently borrow from other countries, and this is just going to add to the drain on our balance of payments. It will add another $100 billion over the course of the decade ahead.

The CHAIRMAN. Now, you saw those charts showing trends in oil prices in relationship to unemployment, interest rates, GNP, et cetera. What does that tell you as you project an oil deficit equal to the trade deficit in the mid-1990s?

Dr. SCHLESINGER. A rise in oil price cuts two ways. On the one hand, it somewhat alleviates our national security concerns because it stimulates domestic production, and to some extent limits domestic consumption.

On the other hand, a rise in oil price means severe macroeconomic problems. It raises interest rates, it slows down economic growth, it raises unemployment, it raises the rate of price increase.

If the Central Bank fights it the consequence will be even slower economic growth.

So driving up the oil price creates from the supply side severe problems for the macroeconomic authorities, and inevitably domestic macroeconomic problems—indeed, world macroeconomic problems. In the 1960s Europe was growing at something in excess of 3 percent per year in terms of economic output. After 1973, it grew at about 8/10ths of a percent.

The Europeans are more dependent on external sources of supply. They were more hit by the rise in oil price than we were, and economic growth slowed down even more than here.

The **Chairman**. One final question, with apologies to my colleagues for taking so long, we have legislation pending which would increase the size of the strategic petroleum reserve to 1 billion barrels, instead of this presently authorized 750 million. Should we go to 1 billion, or stay where we are, and why?

Dr. **Schlesinger**. We should go to 1 billion, at least. I mentioned in my testimony, what we have seen in these last three years is a steady decline in the real, strategic petroleum reserve. That reserve provides protection against a decline in imports, and as our import dependency has risen, the value of that in terms of protection has declined. I think we should go to the billion barrels that was originally considered as a possible target but not authorized.

In fact, if you use the same logic that we have used—we as a country have used for other strategic materials like copper, cobalt, molybdenum or talc, what we have tried to maintain is a domestic stockpile equal to two years in the event of a total cut-off. That would be a much higher number, Mr. Chairman, than 1 billion barrels. It would be in the 2 to 3 billion barrel range.

The **Chairman**. Senator Ford?

Senator **Ford**. Back in the same old place, are we not, Mr. Secretary?

Let me see if I understand you correctly. We have, in round figures, a $50 billion deficit in balance of trade with Japan, in round figures $50 billion deficit in oil imports, and the rest of the world it is about $10 billion. As of 1989 I think what it was was $108 billion, something like that, when we talk about round numbers.

So if we eliminate the trade deficit with Japan, we eliminate the trade deficit with the rest of the world, our oil deficit as you see it could more than triple that—well, another $50 billion in addition, so it would triple from a $50 billion deficit today in oil to approximately $150 to $170 billion by the end of the decade, or sooner?

Dr. **Schlesinger**. If we were to eliminate the trade deficit outside of oil, which amounts to about $65 billion at the present time, and if oil imports were to continue to grow and the price of oil continues to rise, as it has recently, and as we project it, we will have the same trade deficit—indeed, slightly higher trade deficit, as we have today.

Senator **Ford**. What has caused the Russians to decline in their productivity? Apparently they have the oil.

Dr. **Schlesinger**. They have a great deal of oil, yes—of prospective oil reserves. They have had an oil industry which is technologically backward. That is a very polite statement. I could be much harsher.

Their recent troubles in Azerbaijan have been substantial. Now, the Azerbaijan region produces only 2 percent of Soviet oil at the present, but about 70 percent of Soviet oil and gas field equipment. And that production of oil and gas field equipment has plummeted during the recent problems, and it is not going to be restored.

For one thing, there were Armenian managers of these plants and Azerbaijani workers. That has changed. The Armenians have departed. They have brought in Russian managers to replace the Armenians. But the Russians do not speak Aizeri. And as a consequence, the departure of the Armenian managers means that there will be great difficulty in getting production back up.

Moreover, the Soviet Union has decided that it was investing far too much in oil and energy, and is cutting back sharply on energy investment, at the very same time that these other difficulties have occurred.

So production is likely to drop about half a million barrels a day this year. And probably will do so for another couple of years. There is an attempt to bring in outside firms, the international companies, to develop their prospective oil fields, but I think that it will take four to five years at best before they get any results from that.

Senator **Ford**. Will the Russians, then, be purchasing outside sources of oil, or will they be in the OPEC area of purchasing oil, like we are?

Dr. **Schlesinger**. No, they will not be. They have been exporting about 3.5 million barrels a day in total; about two million to the free world, about 1.5 million, roughly, to the Bloc. That is falling, and it will continue to fall. And they will be down to about two million barrels a day of exports.

They will not be dependent on the outside world. However, they make their contribution to free world oil supply by their net exports. That contribution will diminish, and the call on OPEC will rise.

Senator **Ford**. It will come from the other countries which they supply.

You said in your statement, I think, that the United States has been the principal engine in restoring OPEC's power.

Dr. **Schlesinger**. Yes, sir.

Senator **Ford**. Is there anything that they need from us, that general area, other than military equipment?

Dr. **Schlesinger**. We have, in the past, provided considerable construction activity in the region. American engineering firms have been out there, airports, hospitals, universities and the like. In the ways of luxury goods, they have tended, I think, to turn more to European sources than to the United States.

Very briefly, they have valued us and continue to value us because the United States is the only credible source of military protection.

Senator **Ford**. Senator Johnston asked you about the petroleum reserve, and you indicated we ought to go well beyond the billion barrels. I believe we discussed last week the leasing provision, where we, as I understand it, lease oil and let it remain there until we need it as a form of storage, yet we would have access to that.

Do you have any thoughts about that particular provision?

Dr. **Schlesinger**. Yes, sir, I am for it if that is the only way that we are going to move ahead with building up our strategic petroleum reserve, and avoiding the erosion of the days of import that that reserve represents.

We all understand that the U.S. budget is under severe pressure. This is a way of expanding the reserve at the same time one does not augment radically the substantial pressure.

Senator **Ford**. Of course that means that our oil is there, instead of here, if we lease in other areas of the world.

Dr. **Schlesinger**. Well, the proposal that I had in mind, Senator Ford, is that we build additional storage capacity, or somebody builds it on a lease basis here in the United States, and that that oil would be placed here, it would be owned by that foreign government, but we would have the rights to drill on it in an emergency. And I think that that is the ideal way to do it, to bring it here.

Senator **Ford**. I remember when we had a discussion in Room 207 over in the Capitol Building, I guess roughly, oh, 11 or 12 years ago, and you asked the question, what is the percentage we should have of imported oil? And I think we decided 30 percent was probably the maximum. We have about doubled that now.

Dr. **Schlesinger**. We are on the way to doubling that.

Senator **Ford**. Yes, we are on the way to doubling that.

It does not take very long for it to happen, too. We are just kind of waddling along, knowing it is coming, and just waiting for it to hit.

Thank you, Mr. Chairman.

The **Chairman**. Thank you, Senator Ford.

Senator Murkowski.

Senator **Murkowski**. Thank you, Mr. Chairman. And thank you, Dr. Schlesinger. I think you very vividly portrayed the reality that the over abundance of production capability has now reached doomsday, almost, in the sense of we are almost there and it is a call for action.

I am interested in one of the charts that the staff prepared, I believe, relative to oil prices and unemployment. I am wondering if you could identify the area of the economy in which you would predict unemployment would be likely to occur as a consequence of an increase in oil prices?

You mentioned inflation and interest rates increasing, and so forth.

Dr. **Schlesinger**. The unemployment would likely rise in the capital goods industry. And particularly in terms of domestic production of durable consumer goods, like automobiles and so forth. When the public feels troubled, what it does is to cut back what it can cut back. And those are consumer durables. It will not cut back on normal purchases, groceries and what not.

Senator **Murkowski**. So one could presume that our automobile industry may be, in addition to the pressures by clear air mandatory legislation, have the exposure of less buying as a consequence of an increase in oil prices, and resulting unemployment.

You mentioned that East Germany, as a consequence of coming into the unification issue, will be using more energy, and I would agree. What is your estimate for the Pacific Rim countries, the tremendous productivity, as we see Korea and Taiwan and Japan staying at a sustained level?

Dr. SCHLESINGER. That has been the chief area of growth of world oil demand in recent years in percentage terms. Countries like Thailand and Malaysia, Singapore, Taiwan, have been growing in terms of oil demand at 30 percent per annum.

Japan has been growing recently more rapidly than the United States.

Now the United States has increased its consumption more because it is a larger base. But the great driving force now is that force of people who used to use bicycles and moved up to motorbikes, those who have moved up from motorbikes to motorcycles, those from motorcycles to automobiles. And that is driving gasoline demand immensely, and particularly in the Pacific Rim.

Senator MURKOWSKI. We have been meeting our commitments to SPR. We have these naval petroleum reserves scattered around the country, which perhaps were an antiquated idea. I gather the California field behind Bakersfield continues to produce at a modest rate.

Dr. SCHLESINGER. Elk Hills.

Senator MURKOWSKI. Elk Hills.

We have naval petroleum reserve number four. We must have a couple more, in between, somewhere.

Dr. SCHLESINGER. Two more.

Senator MURKOWSKI. How do those fit into our strategic petroleum forecast. SPR, we have it, okay. But these reserves were conceived during a time frame when we were, I gather, looking at the requirements for our fleet worldwide, and so forth.

Should you have recommendations on whether anything should be done with those, or should we open them up to the private sector, or have they just kind of fallen by the wayside?

Dr. SCHLESINGER. Well, I would open them up to the private sector before you came to the Senate, Senator. I was drilling in naval petroleum reserve number four. I think that was when I was Secretary of Defense. We drilled 11 holes and we had 11 dry holes, which led to some discouragement about the ease with which one achieved success in oil drilling.

Those are kind of an obsolescent concept now that we have a strategic petroleum reserve. And they were never very effective in terms of maintaining the capacity to move the fleet quickly, because one would have to develop those fields. Only Elk Hills really was capable of immediate production, and only about 150,000.

Senator MURKOWSKI. So you do not see these focusing into a pattern of relief?

Dr. SCHLESINGER. No, I think what we want to do, probably, is to allow industry to develop those oil fields, if they are there, and to put the benefits into the strategic petroleum reserve, so that it is immediately available.

Senator MURKOWSKI. My last question, and I am sure the Chairman expected it, along these lines of calling for action, but you mentioned the decline in Prudhoe Bay, and our forecasts indicate that by the end of the century, Prudhoe Bay's production will decline from around two million barrels a day—it is a little less than that—to roughly half that.

And the realization that the prospects in ANWR, from the standpoint of the very favorable geology, indicate that it is in the national energy security interest of our nation to initiate a proposal to make a determination of whether there is recoverable reserves there in ANWR, and whether those recoverable reserves can be made available.

And with the accident of the Exxon Valdez, there is a presumption out there that is fostered by the environmental community that would suggest that the Exxon Valdez accident is proof that you cannot open up and produce ANWR safely.

Do you have any suggestions on how to communicate something to the contrary?

Dr. **Schlesinger**. Well, we have been producing the North Slope with greater effectiveness than was predicted in 1969-1970, the time that the debate really got rolling. The problem of the Valdez disaster was partly human error, it was partly a reflection of a system that depends on ocean transportation.

Ocean transportation can be made safer. I am not an advocate of it, but if the question is the special problems of Alaskan ports, because of the cold water, then for those ports one can use double-hulled vessels. So one can make transportation even safer.

I am not astonished that in the course of producing the largest oil field ever found in North America, and we have now produced something approaching eight billion barrels out of that field, that we have had an accident. I am not in favor it, needless to say, but I do not find that astonishing.

Now, estimates for the ANWR field run, more or less, five billion barrels smaller, smaller notably than Prudhoe Bay, but nobody knows as yet. I have thought all along that we ought not to act in ignorance, but we ought to explore and know what we are doing if there is five billion barrels there.

At the price of oil that we were talking about a few minutes, ago, that amounts to something on the order of $100 billion worth of oil. It would seem to me to be too much of a drain on our balance of payments, unfair to the citizens of your state, unwise national security policy not to explore and know precisely what it is that we have, and what we will either develop or forego.

The **Chairman**. I think Senator Domenici was next.

Senator **Domenici**. Thank you, Mr. Chairman.

Let me first say to you, Mr. Chairman, this is a rather poorly attended hearing. There is not very much excitement in the air. Nobody seems to be very concerned. I compliment you for doing it. I do not know who is going to listen.

But essentially we will be back in this room, assuming there is still an Energy Committee and assuming you are still Chairman, we will be back within four or five years, six years at the most, and there will not be enough room here in this room.

We will have the meeting in the Caucus Room and the press will be here with all the televisions, because the second most serious crisis for the United States, without any question, is our continued growing dependence upon foreign oil. It is absolutely amazing to this senator that we run around almost totally concerned about the trade deficit with Japan—a serious problem, no doubt about it—and if we were to get that mercantile trade deficit with the world, not just Japan, with everyone, down to zero, we will exceed the current trade deficit with the world in anywhere from seven to ten years with just oil.

If a trade deficit is bad, it is not because of what it does to the balance of payments situation, it is just as bad if it is all oil and related products as it is with 12 countries, led by Japan. I mean, no economist is going to tell us there is any difference.

Having said that, I am very hopeful, I say to you, that the new Secretary of Energy is taking the responsibility of attempting to produce an energy policy seriously, and I think we will find some very exciting ideas and a fair evaluation when he completes his policy proposals.

I think we did a good job in Congress, insisting that they do it, but he also takes it seriously and I assume that you are aware that that is in the process.

Dr. SCHLESINGER. Yes, sir. Yes, sir.

Senator DOMENICI. And it is comprehensive.

Dr. SCHLESINGER. And I believe that it is supposed to be finished by November or December of this year.

Senator DOMENICI. Right, and it is comprehensive and you would agree that we cannot look at the energy crisis just from one particular aspect, it is a very broad-based problem of the free world and of the United States because we are an oil- dependent economy, you would agree with that, would you not?

Dr. SCHLESINGER. Yes, sir.

Senator DOMENICI. Now, having said that I have a couple of questions about the Strategic Petroleum Reserve and American supplies of oil that are not being developed because of current policy.

Dr. Schlesinger, is the Strategic Petroleum Reserve more important as the world becomes more peaceful, or does it remain a problem of the type that we had when we were threatened with cut-offs because of Soviet-American activities in the Middle East?

Let me just suggest that it appears to me the world supply of oil has become a far more important issue for the United States of America and our future than the Strategic Petroleum Reserve, and secondly, whether that world supply of oil is subject to cartel qualities is a much more important issue than the issue of possible cut-offs that were with us for the past decade or so. Would you just answer that quickly?

Dr. SCHLESINGER. The answer to that, in general, is yes.

Senator DOMENICI. So it seems to me that rather than jump into dramatic increases in the Strategic Petroleum reserve that at least we ought to look at how can we use the oil that we know exists in the United States and can be found and brought to the surface, that that ought to be one of the most important policy approaches that the United States takes, and before you answer that, let me put here on the record that in the United States of America, for most oil fields we leave 70 percent of the oil in the ground, so for all we have taken out, we take 30 out and we leave 70 in the ground. That is a matter of structure and of the viscosity of oil, how heavy it is. It just stays there. You add to that fact the fact that we are losing oil wells at a dramatic number by way of them having to be closed up, and therefore we cannot go in and get the oil from under the ground with any ease. We are losing them at the rate of thousands of those wells per year.

Now, it seems to me that that is a reserve that we currently own, the production of which is American investment, American jobs, and American oil. I would think that if there is a way to get that out of the ground reasonably priced that we ought to do that, forthwith, and I submit to you that there is a way to do that. In fact, Mr. Chairman, you were on an enhanced oil recovery bill.

It is absolutely incredible that the United States will not build an incentive into enhanced oil recovery where the oil is already there. We do not have to go look for it. We just get it out of the ground by new technology.

There is an estimate that we would increase our reserves, that which we could count on, by as much as 7 to 8 billion barrels. By just increasing the incentive for those kinds of fields at the rate of 35 to 50 cents a barrel and you will increase that reserve.

Now, it seems to me that is more of a reserve than the Strategic Petroleum Reserve at this point in our history. First, we do not spend the dollars overseas, we spend them here. We pick that oil up and own it, and it will be produced over the next ten or 15 years, and I wonder if you have looked at that?

Dr. SCHLESINGER. Well, I am in favor—I am in favor of providing incentives for enhanced oil recovery that that will diminish the annual bill, the growth of dependency. I am not sure how much, and if you have experts who can tell you that, but I am in general in favor of that.

I do not think that that is a substitute for the Strategic Petroleum Reserve, because the flow of enhanced oil will be quite slow, whereas the purpose of an SPR is to be able to flush it out very quickly in an emergency.

As you have indicated, Senator, however, the classic threat that we have feared of a Soviet move into the oil fields has now diminished, so that that particular problem is less than it has been in the past. Not eliminated—it may come back. However, the problem of just sheer oil capacity out there and what it means for prices is a growing problem.

Senator DOMENICI. My last question—first I thank you for your testimony. Do you know, Mr. Secretary, what the current estimates of world supply of oil are? Does somebody have those, and where they are? I just heard the other day, maybe Saudi Arabia found another monstrous field. I think it is relevant to what we are talking about here.

Dr. SCHLESINGER. The reserves have gone over 1 trillion barrels, I believe, for the first time. The reserves are not the problem. It is the capacity to produce short-term.

Senator DOMENICI. Well, I am not talking about our reserves, the Strategic Petroleum Reserves.

Dr. SCHLESINGER. The foreign reserves are 1 trillion barrels, roughly. The ability to produce those reserves as indicated is now being exhausted. The difference between today and the last time I testified before this Committee is that spare capacity for the production of oil has melted away, and we are now down to about 1.5 barrels of spare production capacity. It is reflected in the buoyancy of this market.

If there were a way to develop the trillion barrels of reserves out there so that greater production would flow, we would not have this problem—we would not have this prospective problem.

Senator **Domenici**. What is the risk we are trying to protect against by building up the Strategic Petroleum Reserve?

Dr. **Schlesinger**. The building of the Strategic Petroleum Reserve—I want to be sure I use the right words—what I have argued here, is that we ought not to allow that protection to diminish because we had 100 days of in-port supply in the reserve and we are going to go down to 60. We have already gone down to about 80 days. So it is not a question of building the reserve, it is a question of sustaining the present level of protection.

What we are attempting to protect against, as you indicate, are two things. the possibility at some future date that the Soviet Union, which is near at hand, in a revised political military posture, might move into those oil fields. That probability has diminished sharply in this last year, but it has not diminished to zero.

Also, that one has further troubles in the Gulf, for example, and it is clear that the Iranians continue to be restless, and restless they are, and restless they are going to remain, and that through the use of commandos or sabotage, they can do immense damage quickly.

It is against those kinds of things that we provide protection through the SPR. However, I agree with your premise, which is that the need for that protection has diminished as a result of the developments, the end of the tanker war and the end of Soviet attention on outside targets.

The **Chairman**. Would the Senator yield at that point?

Senator **Domenici**. I will be pleased to. I have only one more question, but I will yield now.

The **Chairman**. Would not another reason be to manage economically the price of oil, if you have a big enough reserve, to guard against these spikes?

Dr. **Schlesinger**. That is another potential use of that. I put that in as part of the consequence of a cut-off, because a cut-off becomes simply a price spike. The fear of a price spike is either do to a cut-off or is due to a sudden running out of capacity, and that last can be influenced by activities like sabotage in a region given to terrorist activities.

Senator **Domenici**. Mr. Chairman, I am not against a Strategic Petroleum Reserve at all. I think the much greater danger to the United States is gradual increase in the price and increased dependence, which are going to milk the American economy and then cause it to have diminished prosperity, and nobody seems to understand that. That is the living proof of the past is that we can cut our activity and our growth down and nobody will know that it is 200 billion a year in exported oil that has done it all.

Dr. **Schlesinger**. No argument, senator. I agree with that.

Senator **Domenici**. Let me ask you this question. The tanker issue and the accident issue, frankly we ought to do whatever we can to minimize accidents that occur in bringing oil to the United States on the waterways of the world, but it appears to me that the most significant fact that is going to yield accidents is continued dependence on foreign oil. It seems to me accidents are a function, statistically, of the number of events that occur, and if we continue with that path, and it is brought in by tanker, we will soon double the number of tanker events that have to occur.

Now, if you do not want them from Alaska, then where are they going to come from? They are going to come from somewhere in the world, and it appears to me that you minimize tanker accidents in Alaska by having no oil in Alaska, but do you not maximize tanker accidents occurring somewhere else, just on the sheer ratio of growing dependence?

Dr. SCHLESINGER. Senator, your logic is impeccable. There is no way that we can eliminate the risk of tanker accidents by continuing to allow oil imports to grow.

Senator DOMENICI. Or not producing as much as we can, which is a minimization of it, is it not?

Dr. SCHLESINGER. That is right.

Senator DOMENICI. I have no further questions.

The CHAIRMAN. Senator Conrad?

Senator CONRAD. Thank you, Mr. Chairman. First of all, I was wondering if you have had a chance to examine the clean air legislation which is moving through Congress now and do any tentative evaluation on how that might affect the dynamics that we have been talking about here this morning?

Dr. SCHLESINGER. It will slightly, or more than slightly increase the importation of oil.

Senator CONRAD. Can you give us some sense of the range of importance of that legislation with respect to this problem?

Dr. SCHLESINGER. Well, it depends upon so many other variables, but if all those variables were unaffected, I think that you are talking about something on the order of half a million barrels a day of imports expansion, something in that range.

Senator CONRAD. Half a million barrels?

Dr. SCHLESINGER. When this has all worked its way out, and once again I emphasize that there are many other variables that could be influenced that would diminish that, if we chose to take advantage of those other variables.

Senator CONRAD. The second thing I wanted to ask you was, with respect to the Strategic Petroleum Reserve. Are you familiar with a proposal that has been made that we make an arrangement with the Saudis whereby they would be able to store oil that they maintained title to in our strategic reserve, that we pay them some modest holding charge for that per year—several dollars a barrel perhaps—and then we have a shared appreciation agreement for any price rise that might occur?

It would seem that that would be of benefit to us in terms of providing a Strategic Reserve at a much lower cost than actually paying for the oil at this time, and it would also have some positive benefits for them. That is, they would have assured access to the market, they would have oil in place outside of their own country in case of problems in the shipping channels. Have you heard of a proposal like this, and what is your reaction to it?

Dr. SCHLESINGER. I discussed that with Senator Ford a little earlier. I am in general in favor of moving in that direction. I would prefer, of course that we not become so dependent on lease arrangements as we appear to be going, but it is better to pay the money for the lease of the oil than not to have the reserve.

I would prefer to have a capital outlay while oil prices are relatively low and while there is some spare capacity out there. We had better move fast, by the way. If we hit that ceiling in a couple of years time, there is not going to be that oil to put into that reserve.

Senator CONRAD. The third question I have is if you are familiar with horizontal drilling, and what prospects that holds for expanding the reserves that we have in this country? We have, just in my home State of North Dakota, had some spectacular successes with horizontal drilling. The chief problem seems to be a shortage of the expertise and the equipment nationally to take advantage of the technology. Are you familiar with the horizontal drilling technique?

Dr. SCHLESINGER. Yes, sir.

Senator CONRAD. What prospects does that hold?

Dr. SCHLESINGER. I think that they provide a great promise, and it deals with the issue that Senator Domenici raised earlier of that 70 percent of oil that remains in the ground that through horizontal drilling we will be able to reclaim some of that oil that in the past has not been economically retrievable. It is very promising. It will add to our reserves. It will add to our domestic production.

Senator CONRAD. What should we be doing by way of Federal policy to make that all more possible?

Dr. SCHLESINGER. Well, I think that Federal policy, in circumstances of the sort that we are facing, should provide tax relief for development of this kind of equipment, development of the expertise to handle that kind of equipment, and in that way encourage that development.

I have felt in the past that the Federal Government, for producers who are unable to fund themselves at the present time, might be prepared to establish an energy bank. We have a Solar Bank. It seems to me to be valid to consider an Energy Bank, particularly under circumstances in which the principal producing area of the country—the Southwest—I do not know about banking conditions in North Dakota, Senator Conrad, but in the principal producing region of the country the difficulty in obtaining credit has become very substantial, even for good prospects.

If the credit were more available, we would have moved along more rapidly with horizontal drilling in the Southwest. It is dependent upon cash.

Senator CONRAD. How significant a development do you see horizontal drilling being, potentially?

Dr. SCHLESINGER. I think that this may add three or four years of production at roughly the present levels of production, even what we see at the present time, and that is enormously important.

Senator CONRAD. One final question which goes to this whole issue of double hulls. I do not know if anyone else has had a chance to ask that question. I find myself being unclear as to the value of double hulling vessels. I go home and almost every other week we seem to have another spill, and people are beginning to wonder. What is it that we cannot do something about? I have had people suggest to me that, well, I do not see why you guys do not require all these ships to be double hulled. That would take care of the problem.

In your judgment, how much reliance should we put on the double hulling? Is that a good idea, or is it one of those ideas that sounds like a good idea and is really not so good an idea?

Dr. **Schlesinger**. It is a complex idea. Let me say that we are going in the opposite direction from the one which we are talking about. We have not produced much in the way of tankers since the 1970s. The tanker fleet is, on average, 16 years of age at the present time. Those tankers are getting older. The likelihood of accidents and the likelihood of spills grows.

Meanwhile, we talk about theoretical concepts of having a fleet that is double hulled, but the reality is that that tanker fleet is aging and that we are not going to be able to replace it in time, which means that the price of oil transportation can be added to the domestic price of oil two or three years out when we have absorbed the excess tanker capacity.

The first point is we are going in the opposite direction from the one which we are talking about.

The second point is that one has to look very hard, particularly under the existing circumstances, at the advantages or disadvantages of double hulling in terms of cost effectiveness. It is all very easy to say we should spend the money, but as a practical matter we are not going to have a fleet of double hulled tankers for 15 years. There is no way that you can create a fleet instantaneously.

The third point is this. There does seem to be a greater problem of breaking up the impact of oil spills in colder waters such as Prince William Sound.

Now in answer to Senator Murkowski's question, I had some hedging in my answer. I said if it is judged to be essential in order to open up the ANWR Basin to move towards double hulling, then it is better from a national standpoint that we make that decision. That was not the advocacy of double hulling, but it is plain that the biological deterioration of the oil in those cold northern waters is slower than was that vast oil spill off the coast of Brittany just four years ago when an Amoco tanker spilled oil. Everyone was worried, but the warmth of the Gulf Stream meant that the biological deterioration was more rapid.

I am not in the position to judge. I merely throw this out as speculation. It may be that for those cold northern waters we want to have that limited number of double-hulled vessels that we can quickly produce. Incidentally, if that is the decision you have a pretty good instrument in the Jones Act to help you along.

Senator **Conrad**. May I ask just a final question, Mr. Chairman?

Simply, if you were in the United States Senate and there was a measure before you to require double hulling of all vessels, would you vote for or against it?

Dr. **Schlesinger**. At this time I would vote against it.

Senator **Conrad**. Thank you, Mr. Chairman.

The **Chairman**. Senator Murkowski had one short question.

Senator **Murkowski**. If I may, in view of the interest in ANWR, would you support an alternative proposal rather than opening up for leasing to have the government go in and drill to find out if there is any oil there? Then we would know whether it is a matter of concern to our national security interest.

Would you support perhaps a pipeline across Canada rather than moving it by tanker?

Dr. **Schlesinger**. The first question is very easy. The second one is harder.

The answer to the first question is absolutely. Indeed, in 1978 I proposed precisely that, that we go in and explore so that we knew what the resource was instead of having all of the argument that has gone on in the intervening years about whether or not we should lease it or what have you. We really ought to know what we have there.

In answer to the second question, there has been some disappointment, as you are more keenly aware than I, Senator, that the hopes and promises of the oil companies about transportation did not materialize. There was before the decision to move out of Valdez a proposal to run a pipeline across Canada. One would have to look at the economics of that.

If that is necessary for development, I would be in favor of it. It is late in the game, however, to build a new oil pipeline. That amortization of the TAPS pipeline is well advanced at this time, and to start amortization of a new pipeline I would have to look at the finances quite carefully; but it certainly is something to look at.

Senator **Murkowski**. I would just point out the loss of the $2 billion or so in royalties to the Federal Government.

Thank you, Mr. Chairman.

The **Chairman**. Dr. Schlesinger, thank you so much for your testimony. It is very useful to the committee. I am going to send your statement around to all Senators. I hope they read it and understand its implications. We appreciate it very much.

Dr. **Schlesinger**. Thank you, Mr. Chairman.

The **Chairman**. Next we want to welcome the Honorable John J. Easton, Jr., who is Assistant Secretary for International Affairs and Energy Emergencies at the Department of Energy. He is accompanied by Calvin Kilgore, Director of Office and Energy Markets, and David Doane, who is Director of the Office of Oil Policy.

STATEMENT OF JOHN J. EASTON, JR., ASSISTANT SECRETARY, INTERNATIONAL AFFAIRS AND ENERGY EMERGENCIES, DEPARTMENT OF ENERGY

Mr. **Easton**. Mr. Chairman, thank you. I have two colleagues, and I can bring them up during the questions and answers if they are required to answer some of the questions.

It gives me great pleasure to follow someone as distinguished in the field as Dr. Schlesinger and also to join the other two panelists who will be appearing before you to discuss our views of the world oil outlook for the 1990s. Let me give a brief overview, and then I will summarize my written testimony which has been submitted for the record.

I think as Dr. Schmalensee has stated in his testimony, forecasting the oil market is extremely difficult. Having said that, let me give you the overview of what we see at the Department of Energy.

First, we see moderate demand growth; second, a rising dependence on the Persian Gulf or, as Secretary Watkins put it during a National Energy Strategy hearing, collective international dependence on Persian Gulf oil is inevitable; and third, we see the Gulf producers attempting to keep prices stable.

In my mind, the critical issue for us, your committee, our Department and the Nation as a whole, is: Can the Gulf producers expand their productive capacities enough to both meet demand and keep the market stable? The answer to that question will probably determine what the outlook for the 1990s is.

In my written remarks I cover four areas. I discuss worldwide oil consumption which we see increasing; secondly, the U.S. outlook; third, the potential for growth in supply, both within OPEC, the U.S. and non-OPEC nations; and then, finally, I will touch on the implications for U.S. policy.

First, we have seen over the past few years an increase in the demand for oil due to increased consumption of transportation fuels and increasing use in electric power generation. Looking ahead to the 1990s we see that worldwide oil consumption will increase in the market economies by over five million barrels a day, and we see by the year 2000 worldwide demand in excess of 69 million barrels a day. The strongest economic growth, as Dr. Schlesinger mentioned, is going to be in the Far East.

I should say that these scenarios do not include any reference to Eastern Europe. At this point in Eastern Europe we do not expect a sudden surge in energy demand. It will take a while for their economies to get in place. Then, however, we could see higher economic activity, rising incomes, and the satisfaction of pent-up consumer demand increasing the demand for energy.

On the other hand, however, as the Eastern Europeans shift to a market economy we could see energy being used more efficiently, and we could see the replacement of some old, heavy industrial facilities with more energy efficient technology.

What is the outlook in the United States? We see the outlook as growing by a million barrels per day by the year 1995.

The CHAIRMAN. Would you hold for just a second?

Senator DOMENICI. Would you hold just for one minute?

Mr. Chairman, I am not going to be able to stay, and I wanted to tell the witness that I will review his testimony.

Mr. Chairman, at the close of my questions I neglected to ask if a coal methane resource map of the United States could be inserted in the record immediately following Dr. Schlesinger's testimony. I think, Mr. Chairman, if you are not interested yourself in this issue, I would suggest that it is one of the most dramatic sources of new natural gas in the United States. The estimate is 400 trillion cubic feet. We use less than 20 a year. They finally found out how to produce it in an environmentally sound manner.

This map is interesting for you and me because normally a resource such as this is very regional. You are talking about the south or Louisiana and the southwest. This source of natural gas is national; in fact, Appalachia, northeastern America. It seems to me that while we have a tax credit, it expires in a year and we will lose this reserve. This is a very, very significant issue for our future, and I have asked that it be made a part of the record.

The CHAIRMAN. Yes. Without objection, that will be made a part of the record.

Senator DOMENICI. I thank you very much.

The CHAIRMAN. Thank you.

Please proceed.

Mr. EASTON. I might add, Mr. Chairman, I just visited our centers both at Morgantown and Pittsburgh, and they are doing some very interesting work in this area, realizing the potential that Senator Domenici mentions. I think those areas do hold great promise, and our technology centers are looking into them.

I was mentioning the world outlook. In the U.S. outlook we see the growth of demand in the U.S. rising about 1 million barrels per day by 1995 and adding another 600,000 barrels per day by the year 2000. We think that this could be changed, however, by the introduction of alternate fuels, or higher than expected oil prices which could modify these projections.

Growing imports do, indeed, create energy security concerns, and these concerns are that the transportation system could be strained; our domestic refining capacity likewise. As imports increase we are going to need more tankers, as Dr. Schlesinger was stating; new port facilities and storage capacity; increased pipeline capacity; and greater refining capacity. There are also some environmental concerns that we must address in the attainment of air quality objectives. Environmental concerns could indeed slow the construction of new refineries.

Let me next address the potential for supply growth throughout the world. We see non-OPEC production plateauing in the early 1990s. We see production in the United States declining by 1 million barrels per day by 1995, the same amount as our demand in the United States will grow. We see little likelihood in the lower 48 states of finding substantial reserves, although there are thought to be substantial reserves as discussed both in ANWR and the outer continental shelf.

Even with these new reserves, we may be able to slow, but it is unlikely that we will be able to reverse, the decline in U.S. production.

Two-thirds of the world's oil reserves are in the Middle East, virtually all in the Persian Gulf. For example, Saudi Arabia has something like 10 times the reserves we do, 255 billion barrels to our 27 billion. So all eyes really do turn to OPEC, which is currently producing close to 23 million barrels per day, about a million over its self-imposed quota. That number could soon reach 24 million barrels per day. A number of countries, as Dr. Schlesinger said, are already producing at full capacity.

I think one area where perhaps our estimates are a little bit different from his is the present crude production capacity of OPEC. We see this as more like 27 to 28 million barrels per day of present capacity, and that excludes natural gas liquids. Several countries have announced their plans to add a combined additional 6 million barrels by the year 2000. They include Saudi Arabia, Kuwait, Iraq, the UAE and Venezuela; however, some lead time may be required before this capacity comes on line.

I should give you the trend of prices. We see EIA projecting gradually increasing prices from about $18/barrel in 1989 to $20.40/barrel in 1995, increasing to $27.80/barrel by the year 2000.

The CHAIRMAN. All of those are in constant dollars?

Mr. EASTON. That is in 1989 dollars, yes, sir.

I should say that many OPEC producers with substantial reserves have clearly signaled that maintenance of stable oil prices is the best means of protecting the market for their oil, and that is why I stated earlier that we see in the forecast an attempt by these producers to keep stability in the marketplace.

The real power of OPEC, however, will become increasingly concentrated in the hands of a few producers in the years ahead, since many producing countries are already at their limits.

Finally, I should mention, before I talk about U.S. implications, that the increased concern for the environment worldwide is going to cause new specifications on oil transportation, and restrictions on both onshore and offshore leasing. Clean air requirements imposed by the pending Clean Air Act could also affect these predictions of the world oil outlook.

What are the implications for United States policy? First, the world oil market has historically been volatile, and that is unlikely to change in the future. The basis of our concern is not import dependence, per se, but instead the reliance on suppliers who inhabit a region of the world that is subject to turmoil, and I should note that some of these suppliers are U.S. allies who are equally concerned about the political and economic stability of that region.

The U.S. and its OECD partners have taken steps to protect their economies and energy security. Changes in the market and geopolitical conditions have taken place over the last decade, such as the creation of government stockpiles and large downstream investments by OPEC nations in the consumer nations, which we believe have acted to reduce the risk of major disruptions.

The U.S. has maintained a successful policy of reliance on market forces, and yet during the months ahead we will continue to be completing analysis to identify impediments to effective market reliance that may be resulting in more consumption or less domestic production than would otherwise be the case.

Among the policies at our disposal are those that encourage greater cost-effective conservation and increased efficiency, that improve the productivity of our domestic wells, that manage the difficult trade-offs between environmental protection and the exploration of new areas, that increase inter-fuel competition, and finally, that remove barriers to the advent of new technology.

Another policy area that should not be overlooked is the use of diplomacy to bring peace to the region of the world that for too long has been subject to conflict. In sum, our concern should be directed at seizing opportunities for change and improvement in how we perform as a productive nation.

This is a brief picture of the emerging world oil market. We are closely monitoring the issues of refining capacity, crude oil supply availability, worldwide tanker capacity, the developments within OPEC, and consumption trends both here and abroad.

Mr. Chairman, I would be happy to take your questions.

[The prepared statement of Mr. Easton follows.]

Statement of John J. Easton, Jr.
Assistant Secretary of Energy
International Affairs and Energy Emergencies
before
The Senate Committee on Energy and Natural Resources
March 26, 1990

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Mr. Chairman and Members of the Committee, I appreciate this opportunity to present the Department of Energy's views on the world oil outlook. This morning I will outline the general trends that we at the Department foresee for the oil market of the 1990's, and how these trends may differ from recent history. The source for the trends and projections discussed in this testimony is the Energy Information Administration's upcoming International Energy Outlook 1990 which will be available on March 30, 1990.

Following the oil price crash in 1986, the second-half of the 1980's brought an abundance of relatively low-cost energy. Low world oil prices helped to fuel continuing economic growth at home and abroad. They also had a number of other consequences. Together with general economic growth, lower oil prices have resulted in a steady rise in world oil demand. In 1988, world oil consumption outside of centrally planned economies exceeded 50 million barrels per day for the first time since 1979. Although the trend in rising consumption in the United States and Western Europe appears to be tapering off somewhat as we enter the 1990's, it continues its strong rise in the Pacific Basin, and in the developing world in general. As worldwide consumption increases, excess production capacity is projected to be increasingly concentrated in the Persian Gulf.

Increase in Worldwide Consumption of Oil

One reason for the growth in oil consumption over the last few years was the increase in demand for transportation fuels, both in the industrialized countries and in the developing world. In addition in recent years, oil consumption for electric power generation has risen, modestly in the U.S. and more significantly elsewhere, as its price relative to other fuels has fallen.

Looking ahead into the 1990's, oil demand growth is forecast to continue, although at a slower pace. Worldwide oil consumption, including the Centrally Planned Economies, is projected (by EIA) to be 66 mmbd in 1990; 69 mmbd in 1995; and slightly above 69 mmbd by 2000. Demand growth in the United States and Western Europe is expected to remain relatively flat due to slower growth in economic activity and continued gains in energy efficiency. However, projected strong economic growth in the the Far East and parts of the developing world is expected to sustain oil demand growth rates of 2-3 percent per year, in those areas. This, in turn, is expected to cause worldwide oil consumption to increase by approximately 1-2 percent per year in the early 1990's. This translates into a projected annual increase in consumption of nearly 1 million barrels per day during this period.

This projected 1 million barrel per day increase in global consumption does not take into account recent developments in Eastern Europe. We do not expect a sudden surge in energy demand in Eastern Europe. Over time, however, we may see increased demand for energy resulting from higher economic activity, rising incomes, and the satisfaction of pent-up consumer demands. On the other hand, the elimination of government subsidies for energy in many Eastern European countries will cause energy to be used more efficiently. The replacement of old, heavy industrial facilities with new, more energy efficient technology, may also reduce energy demand. Movement toward a free-market system in the Soviet Union could both stimulate economic activity and lead to a rise in the domestic demand for, and at the same time increase efficiency in the use of, energy. In the longer-term, this could lead to a decline in Soviet oil exports to the rest of the world unless the Soviets take steps to restrain oil demand, improve efficiency, and encourage fuel substitution. By the same token, if the U.S.S.R.'s oil sector is opened to, and attracts, outside investment, the current trend of declining U.S.S.R. oil production and exports could be slowed or reversed. It should be noted, however, that more realistic pricing of fuels, economic adjustments from restructuring, and increased environmental awareness may tend to slow consumption growth in the near-term in the Soviet Union, and perhaps to a lesser extent in Eastern Europe.

U.S. Outlook

U.S. petroleum demand is expected to grow by a little less than 1% per year in the first half of the 1990's, or by an additional 1 million barrels per day between now and 1995, based on the assumption of 2-3 percent GNP growth and an average price of approximately $18/barrel in 1989 dollars. Slightly slower demand growth is expected in the second half of the 1990's, assuming a 2-3 percent GNP growth and an average price of $25/barrel in 1989 dollars, adding some 600,000 barrels per day to U.S. consumption by the year 2000. This growth in U.S. consumption is projected to be accompanied by an almost equal decline in U.S. domestic production. On a net basis, the United

States imported approximately 7.1 million barrels per day of crude oil and petroleum products in 1989, or 41% of consumption. Imports are projected to increase to over 50% of consumption by 1995 and to 55% of consumption by the year 2000. At that point, imports are projected to be 10.5 mmbd. The opening of new areas for oil exploration and development, improved recovery technology, introduction of alternative fuels, or higher than expected oil prices could modify these projections.

Growing oil imports create energy security concerns and could strain the transportation system for crude oil and refined products, as well as our domestic refining capacity. As U.S. crude and product imports increase, more tankers will be needed to transport oil to the United States, new port facilities and storage capacity will be necessary, increased pipeline capacity will be needed to transport the oil from the U.S. Gulf Coast to the mid-continent, and greater refining capacity will be needed to produce increased amounts of the lighter, cleaner petroleum products required for compliance with environmental regulations. Environmental concerns associated with siting and the attainment of air quality objectives will slow the construction of new refineries in the U.S. and possibly in Europe, and Japan. These and other structural constraints reduce the margin of flexibility to cope with unexpected increases in demand or supply interruptions. As a result of the short-lived heating oil and propane deliverability problems experienced in some sections of the country last December, the Department of Energy is stepping up its monitoring efforts in an attempt to identify potential transportation and supply problems before they emerge.

Potential for Supply Growth

Non-OPEC production in the Market Economies grew from 21 million barrels per day in 1979 to 27 million barrels per day in 1989. Current projections, however, show non-OPEC production reaching a plateau in the early 1990's. Increasing production in countries such as Norway, Syria, Brazil and North Yemen will not be sufficient in the near to medium term to offset the declines in production in the United States, the U.S.S.R, and other mature areas.

Production in the United States is forecast to decline by 1 million barrels per day by 1995, mainly due to the maturity of most U.S. fields and the decline in drilling activity. This rate of decline can be slowed by the discovery of new fields, by an increase in conventional developmental drilling in existing fields, or by the increased use of enhanced oil recovery (EOR) and other advanced technologies to recover more of what has already been found. Geologists believe that there is very little likelihood of finding large new fields onshore in the lower 48 states. However, substantial reserves are thought to exist in the Outer Continental Shelf (OCS) and in Alaska. Through concerted efforts to find and produce more of our domestic resources, we may be able to slow the rate of decline in U.S. production, but it is unlikely under current conditions that we will be able to reverse the trend.

Almost two thirds of the world's proven oil reserves are in the Middle East, virtually all in the Persian Gulf region. Saudi Arabia claims a proven reserve base of 255 billion barrels of oil as compared to U.S. proven reserves of 27 billion barrels of oil. Relative to OPEC, non-OPEC production prospects appear to be limited by lower proved reserve levels, by the higher cost of productive capacity, and by the lower rates at which new oil is being found.

OPEC has increased its crude oil production in the last five years from 16-17 million barrels per day in 1985 to over 22 million barrels per day in 1989. OPEC is currently producing at close to 23 million barrels per day, which is 1 million barrels per day above its self-imposed quota. In the short-term, while OPEC production will continue to be affected by seasonal swings in consumption, price expectations, and movements into and out of inventory, the annual demand for OPEC crude oil production could soon reach a level of 24 million barrels per day. At this level of production, a number of OPEC countries would be producing at full capacity.

Although OPEC's production capacity stood above 30 million barrels per day in the early 1980's, estimates of its present capacity are closer to 27-28 million barrels per day (excluding natural gas liquids). This indicates an excess capacity of 5 - 6 mmbd, which fluctuates seasonally by 1-2 mmbd. The significance of these numbers becomes apparent in light of the anticipated plateau in non-OPEC production, which could leave OPEC as the sole supplier of the projected 1 million barrels per day of additional demand per year.

A number of OPEC countries, primarily those with large reserves, have announced plans to increase their production capacity. Saudi Arabia, Kuwait, Iraq, the United Arab Emirates, and Venezuela have announced plans to add an additional 6 million barrels per day to current capacity by the year 2000. If these countries do indeed add to their production capacity as planned, some lead-time will be required before this new capacity will be in-place and operating. Due to the expected gradual tightening in the supply/demand balance, DOE now foresees a gradually increasing real price for oil as the most likely scenario for the 1990's. EIA's projections show real crude oil prices in 1989 dollars per barrel rising from $17.70 in 1989 to $20.40 in 1995 and to $27.80 by the year 2000.

If rising consumption continues and if additional capacity is not brought on line as planned, the oil market may become more sensitive to potential, short-term disruptions in the system, whether they are caused by accidents such as those that occurred in Alaska or the North Sea, unusual weather patterns, transportation bottlenecks, war, or, less likely by politically-motivated curtailments of supply. On balance, there may be greater likelihood that prices will be volatile in the upward, rather than the downward, direction in the 1990's. Sustained higher prices, as experience has shown, have the effect of stimulating production in non-OPEC countries. If the price increase is significant, it will also stimulate conservation, investments in new efficiency technology, and fuel-switching.

Many OPEC oil producers with substantial reserves have clearly signaled their belief that the maintenance of stable oil prices is the best means of protecting the market for their oil in the longer-run. Others within OPEC, those producing closer to full capacity, continue to argue for higher oil prices today as the best way to maximize oil revenues over the expected life of their reserves. As OPEC as a whole regains market share in the 1990's, the concern over production sharing that dominated OPEC's deliberations in the past several years is likely to recede. The real power over price within OPEC will increasingly be concentrated in the hands of those few key producers with the ability to expand capacity. The ultimate outcome of these trends will depend upon numerous factors including the collective behavior of OPEC, bilateral relations between individual OPEC member countries, and consuming nations, and the actions of consumers. Producers and consumers alike, however, may have less control over the price of oil in the 1990's if the margin of spare production capacity does not keep pace with growing demand.

Finally, I would like to mention one additional variable which may begin to impact the world oil market of the 1990's, and that is increased concern for protection of the environment. There are three main areas where new environmental regulations can be expected to have an impact on the world oil market: 1) new specifications and limitations on oil transportation by tanker; 2) restrictions on federal on-shore and off-shore leasing, exploration and development; and 3) clean air requirements affecting refinery output. The Clean Air Act, which is currently being debated here in the Senate, will have an impact on the world oil market if it includes a call for alternative fuels, including reformulated gasoline, and for tougher clean air standards affecting U.S. refineries.

Environmental legislation can be expected to increase operating costs throughout the oil industry, including the costs involved in production (especially offshore), refining, and transportation. It is also likely to encourage exploration and refining capacity to move outside the United States. As these higher costs are passed on to consumers, they will cause petroleum product prices to rise faster than crude oil prices. Higher prices would induce some reduction in petroleum demand, and serve to ease the projected tightening supply/demand balance.

Implications for U.S. Policy

The world oil market has historically been volatile. This is unlikely to change in the future, or until technology or other factors provide the means to reduce the world's dependence on oil. The basis of our concern is not import dependence per se, but our reliance on suppliers who inhabit a region of the world that is subject to turmoil. I should note that some of these suppliers are U.S. allies who are equally concerned about political and economic stability in the region.

The U.S. and its OECD partners have taken steps to protect their economies against potential disruptions in the oil market. They have invested heavily in building strategic supplies that can be used in such an eventuality. The U.S. Strategic Petroleum Reserve, and the reserves of our European and Asian partners, in their current and planned size, are capable of minimizing the effects of interruptions far larger than those experienced in the last fifty years. Changes in market and geopolitical conditions over the last decade, such as the creation of these large government stockpiles and the large downstream investments by OPEC nations in consumer nations, have acted to reduce the risk of major disruptions.

The U.S. has maintained the successful policy of reliance on market forces. Over the coming months, in conjunction with the preparation of the National Energy Strategy, we will be completing analyses to identify impediments to effective market reliance that may be resulting in more consumption or less domestic production than would otherwise be the case. The National Energy Strategy, to be effective, must be crafted so that we will not trade a reduction in concern for a reduction in economic efficiency.

Among the policies at our disposal are those that encourage greater cost-effective conservation and increased efficiency in oil use, improve the productivity of our domestic wells, manage the difficult trade-offs between environmental protection and exploration of new areas, increase inter-fuel competition, and remove barriers to the advent of new technology and innovation.

Other policy areas involve the use of diplomacy to bring peace to a region of the world that has for too long been subject to conflict. We have also the ability to transfer knowledge and technology to regions of the world that currently use oil less efficiently than necessary.

In sum, our concerns should be directed at seizing opportunities for change and for improvement in how we perform as a productive nation. They should not engender paralysis or defensive behavior nor calls for precipitous action or ineffective intervention.

I have presented a brief picture of the emerging world oil market of the 1990's. The Department of Energy is closely monitoring issues such as U.S. refining capacity, crude oil supply availability, both domestic and imported, worldwide tanker capacity, developments within OPEC, and consumption trends both here and elsewhere in the world. We plan to keep policymakers in the Administration, as well as members of Congress, informed about developments in these critical areas and the actions the Department thinks are necessary to address potential, future problems.

Thank you. This concludes my prepared statement, and I would be glad to answer any questions you may have.

STATISTICAL ANNEX

taken from

The Energy Information Administration's

International Energy Outlook 1990

Available March 30, 1990

Table B1. Annual Growth Rates of Real Gross Domestic Product (GDP): Base Case, 1970-2010
(Percent)

Country/Region	Average Annual GDP Growth Rates				
	1970-1980	1980-1985	1985-1990	1990-2000	2000-2010
World	3.7	2.2	3.4	2.5	2.4
Market Economies	3.6	2.1	3.3	2.4	2.4
Total OECD	3.1	2.3	3.2	2.3	2.2
United States[a]	2.7	2.6	3.1	2.5	2.3
Canada	4.6	2.9	3.4	2.6	2.4
Japan	4.6	3.9	4.2	2.6	2.3
OECD Europe	3.0	1.6	3.0	2.0	1.9
Developing Countries	5.4	1.3	3.5	2.9	3.0
OPEC	5.9	-2.3	2.0	2.7	3.0
Other	5.2	2.7	4.0	3.0	3.0
Centrally Planned Economies	3.9	2.6	3.7	2.7	2.5
Soviet Union	3.2	2.2	3.5	2.4	2.1
China	NA	10.0	9.2	4.5	4.2

[a] Projected growth rates are of Gross National Product (GNP).

OECD = Organization for Economic Cooperation and Development.

NA = Not available.

Note: Aggregate growth rates are calculated from aggregate real gross domestic product in 1980 dollars at 1980 exchange rates.

Sources: **History**: Wharton Econometric Forecasting Associates, World Economic Service Historical Data, December 1989 (1989). **Projections**: Energy Information Administration, *Annual Energy Outlook 1990*, DOE/EIA-0383(90) (1990); Wharton Econometric Forecasting Associates, *World Economic Outlook* (October 1989); **Beyond 2000**: GDP/per capita ratios from the Worldwide Integrated Nuclear Evaluation System (WINES89) times population projections from United Nations, *World Population Projections 1988* (New York, NY, 1989).

Table A1. World Oil Prices, 1979-2010
(1989 Dollars per Barrel)

Year	Price Case-1989 Dollars per Barrel		
	Low	Middle	High
1979		$ 34.88	
1980		50.02	
1981		49.84	
1982		42.44	
1983		35.71	
1984		33.86	
1985		30.76	
1986		15.55	
1987		19.49	
1988		15.18	
1989	$17.10	17.70	$18.30
1990	14.40	16.80	19.20
1991	14.40	16.10	20.50
1992	14.40	16.50	21.90
1993	14.30	18.00	23.20
1994	14.30	19.40	24.60
1995	14.30	20.40	25.90
1996	15.40	21.90	27.50
1997	16.50	23.50	29.10
1998	17.60	25.20	30.70
1999	18.70	26.70	32.30
2000	19.80	27.80	33.90
2001	20.60	29.00	35.50
2002	21.40	30.00	37.10
2003	22.30	31.10	38.70
2004	23.10	32.00	40.30
2005	23.90	32.90	41.90
2006	24.30	33.80	43.00
2007	24.70	34.70	44.10
2008	25.10	35.50	45.20
2009	25.50	36.20	46.30
2010	25.90	36.90	47.40

Note: Prices represent the U.S. refiner acquisition cost of imported crude oil.

Source: **History**: Energy Information Administration, Monthly Energy Review, DOE/EIA-0035(89/09)(1989). **Projections**: Energy Information Administration, Oil Market Simulation Model, Oil Market Simulation User's Manual, DOE/EIA-MO28(90).

Table F1. International Petroleum Supply and Disposition: BASE (Million Barrels per Day)

	Year							Annual Percent Growth
Supply and Disposition	1988	1989	1990	1995	2000	2005	2010	1988-2010
Market Economies								
Production[a]								
U.S. (50 States)	10.47	9.97	9.71	8.97	8.71	8.29	7.83	-1.3%
Canada	2.04	1.99	1.96	2.03	2.10	2.13	2.10	0.1%
OECD Europe	4.44	4.47	4.96	5.29	5.16	4.88	4.44	0.0%
OPEC	22.01	23.44	23.68	26.58	28.47	30.89	34.05	2.0%
Other Countries	10.11	10.24	10.67	11.06	10.73	10.47	10.37	0.1%
Net CPE Exports	**2.43**	**2.30**	**2.20**	**1.92**	**1.53**	**0.79**	**-0.07**	
Total Supply[b]	**51.12**	**51.61**	**52.73**	**55.80**	**56.72**	**57.45**	**58.73**	**0.6%**
Consumption								
U.S. (50 States)	17.28	17.25	17.41	18.21	18.84	19.47	20.32	0.7%
U.S. Territories	0.20	0.21	0.20	0.21	0.22	0.22	0.23	0.6%
Canada	1.60	1.67	1.68	1.91	1.96	1.92	1.90	0.8%
Japan	4.73	5.01	5.20	5.77	5.65	5.33	5.02	0.3%
Australia and New Zealand	0.77	0.80	0.81	0.88	0.91	0.95	1.00	1.2%
OECD Europe	12.36	12.54	12.70	12.92	12.43	12.02	11.82	-0.2%
Other Market Economies	13.80	14.46	15.02	16.21	17.01	17.83	18.75	1.4%
Total Consumption	**50.74**	**51.94**	**53.03**	**56.10**	**57.02**	**57.75**	**59.03**	**0.7%**
Discrepancy	-0.39	0.33	0.29	0.30	0.30	0.30	0.30	
Centrally Planned Economies (CPE)								
Production								
China	2.73	2.73	2.81	2.82	2.77	2.66	2.50	-0.4%
U.S.S.R	12.55	12.23	12.03	11.56	10.48	9.24	8.16	-1.9%
Other	0.46	0.47	0.51	0.42	0.35	0.29	0.24	-2.9%
Consumption								
China	2.13	2.14	2.12	2.11	2.09	2.07	2.02	-0.2%
U.S.S.R	8.86	8.84	8.82	8.50	7.88	7.37	7.06	-1.0%
Other	2.51	2.36	2.40	2.28	2.10	1.95	1.89	-1.3%
World Oil Consumption	**64.23**	**65.28**	**66.37**	**68.99**	**69.09**	**69.14**	**70.00**	**0.4%**

[a] Includes production of crude oil and natural gas liquids, other hydrogen and hydrocarbons for refinery feedstock, refinery gain, alcohol, and liquids produced from coal and other sources.

[b] Includes net stock withdrawals.

Sources: Energy Information Administration (EIA), *Monthly Energy Review*, DOE/EIA-0035(89/07); EIA, *International Energy Annual 1988*, DOE/EIA-0219(88); Organization for Economic Cooperation and Development, Monthly Oil Statistics Database through December 1988; PC-AEO Run DACB212, 01/03/90.

Table B3. Oil Production Capacity, 1989-2010
(Million Barrels per Day)

Country/Region	Estimated 1989	Projection Ranges 1990	1995	2000	2010
United States	10.1	9.7-10.0	8.5- 9.6	7.8- 9.6	7.4- 8.7
Canada	2.0	1.9- 2.1	1.9- 2.1	1.9- 2.3	1.9- 2.3
Mexico	2.9	2.8- 3.0	2.8- 2.9	2.7- 3.1	3.0- 3.4
North Sea	3.8	4.2- 4.5	4.4- 4.9	4.3- 5.0	3.5- 4.3
Other Non-OPEC	8.1	8.1- 8.9	8.0- 9.1	7.6- 9.1	6.7- 8.5
Total Non-OPEC	26.9	27.1-28.0	26.3-27.9	25.6-28.1	23.5-26.0
Algeria	1.2	1.2- 1.2	1.1- 1.2	1.1- 1.2	1.1- 1.4
Ecuador	0.3	0.3- 0.3	0.3- 0.3	0.4- 0.4	0.1- 0.1
Gabon	0.2	0.2- 0.2	0.2- 0.3	0.1- 0.2	0.0- 0.0
Indonesia	1.5	1.5- 1.5	1.5- 1.6	1.4- 1.7	1.5- 1.9
Iran	3.1	3.0- 3.2	3.2- 3.5	3.5- 4.1	4.5- 5.8
Iraq	3.2	3.4- 3.8	3.8- 4.1	5.1- 6.0	5.5- 7.0
Kuwait[a]	2.8	2.8- 3.0	2.8- 3.0	2.8- 3.2	3.2- 4.1
Libya	1.7	1.7- 1.7	1.7- 1.8	1.8- 2.1	2.2- 2.8
Nigeria	1.8	1.8- 1.8	1.6- 1.8	1.5- 1.7	1.5- 1.9
Qatar	0.5	0.5- 0.5	0.5- 0.5	0.5- 0.6	0.6- 0.8
Saudi Arabia[a]	8.3	8.6- 9.0	8.7- 9.4	8.7- 9.8	10.4-13.3
United Arab Emirates	2.3	2.4- 2.4	2.4- 2.6	2.5- 2.9	2.9- 3.8
Venezuela	2.7	2.7- 2.9	2.8- 3.0	3.0- 3.5	3.9- 5.1
Total OPEC	29.4	30.6-31.0	31.4-32.4	33.8-35.8	40.6-44.6
Net CPE Exports	2.3	2.0- 2.4	1.4- 2.4	0.9- 2.1	-0.7- 0.5
Total Market Economies	58.6	60.0-61.1	59.8-62.0	61.4-64.9	64.8-69.7

[a] Includes 50 percent of Neutral Zone Capacity.

CPE = Centrally Planned Economies.

OPEC = Organization of Petroleum Exporting Countries.

Notes: Capacity is defined as maximum sustainable production capacity adjusted to reflect current operable capacity in selected countries. The range in U.S. production capacity is derived from production estimates from the Annual Energy Outlook 1990 plus surge production estimates of about 100,000 barrels per day. Production includes crude oil, natural gas liquids, refinery gains, hydrogen, and other hydrocarbons. All uncertainty ranges are derived independently and do not necessarily equal totals.

Source: Energy Information Administration, Office of Energy Markets and End Use, "International Energy Outlook 1990 Memo to The Record" March 30, 1990.

Table B2. World Crude Oil Reserves and Resources
(Billion Barrels)

Region/Selected Countries	Crude Oil Reserves[a]				Total Resources[b]
	Oil and Gas Journal (1/1/89)	World Oil (1/1/89)	FESAP (Various Dates)		U.S. Geological Survey (1/1/85)
North America	87.7	86.8		NA	139.1 - 280.5
Canada	6.8	7.0		NA	15.3 - 62.6
Mexico	54.1	53.0	27.2	(12/81)	45.0 - 105.0
United States	26.8	26.8	[c]30.4	(12/88)	70.4 - 118.4
Central & South America	68.0	69.8		NA	74.6 - 135.6
Ecuador	1.4	1.2	1.2	(12/82)	3.1 - 8.5
Venezuela	58.1	59.8	18.5	(12/78)	53.7 - 81.7
Western Europe	18.5	18.1		NA	45.1 - 78.1
United Kingdom	5.2	4.3	12.6	(12/81)	19.0 - 23.2
Other North Sea	11.9	11.9	7.0	(12/81)	17.7 - 40.7
Other Western Europe	1.4	1.9		NA	5.2 - 14.2
Eastern Europe and Soviet Union	60.3	62.6		NA	130.0 - 274.0
Soviet Union	58.5	60.9		NA	127.0 - 268.0
Middle East	654.0	584.5	419.2		482.9 - 619.9
Iran	92.9	63.0	62.5	(12/81)	71.1 - 95.1
Iraq	100.0	99.0	34.5	(12/81)	65.7 - 130.7
Kuwait[d]	94.5	98.6	95.7	(12/81)	80.8 - 88.3
Qatar	3.2	2.6	7.1	(12/81)	2.0 - 7.0
Saudi Arabia[d]	255.0	257.5	173.2	(12/81)	193.1 - 239.6
United Arab Emirates	98.1	56.3	43.0	(12/81)	48.7 - 58.7
Africa	56.9	58.8		NA	88.5 - 158.5
Algeria	8.4	8.4	10.4	(12/81)	11.8 - 16.3
Egypt	4.3	4.6	2.4	(12/81)	5.7 - 16.7
Gabon	0.7	0.9		NA	5.0 - 7.0
Libya	22.0	22.4	21.0	(12/81)	29.9 - 40.9
Nigeria	16.0	16.0	12.6	(12/75)	23.2 - 37.2
Other Africa	5.5	6.5		NA	12.1 - 36.1
Far East/Oceania	45.1	43.0		NA	84.8 - 210.8
Australia/New Zealand	1.9	2.5		NA	4.3 - 12.5
China	23.6	22.0	23.6	(12/85)	43.6 - 116.6
Indonesia	8.3	8.4	9.5	(12/82)	13.6 - 26.6
Total OPEC	758.6	694.1		NA	602 - 838
Total Market Economies	906.7	838.8		NA	880 - 1,330
World Total	990.6	923.7		NA	1,060 - 1,720

[a] Reserves include proved reserves and indicated additional reserves in this table. Some foreign countries have a less restrictive definition than EIA of proved reserves that are reported to and published by the various trade journals. Resource data include, in addition to reserves, undiscovered recoverable resources and unproven reserves that are inferred or indicated by engineering or geologic evidence.

[b] Includes a probability range from 95 percent to 5 percent of identified reserves and undiscovered resources.

[c] Energy Information Administration figure published separately (see Sources). This figure includes 26.8 billion barrels of proved reserves and 3.6 billion barrels of indicated additional reserves.

[d] Includes 50 percent of the Neutral Zone. Saudi Arabia revised its oil reserves estimate in January 1989.

NA = Not Available.

OPEC = Organization of Petroleum Exporting Countries.

FESAP = Foreign Energy Supply Assessment Program.

Sources: OE: Oil and Gas Journal 86, 52 (December 26, 1988): World Oil 209,2 (August 1989); Energy Information Administration, Foreign Energy Supply Assessment Program Series regional reports, selected issues, and U.S. Crude Oil Natural Gas and Natural Gas Liquids Reserves, DOE/EIA-0216(88) (1989). All resources: U.S. Department of Interior, Geological Survey, World Resources of Crude Oil, Natural Gas, Natural Bitumen, and Shale Oil (Assessment as of 1/1/85 in Paper delivered at 12th World Petroleum Congress in 1987).

The **Chairman**. Thank you very much, Mr. Easton.

You heard Dr. Schlesinger's testimony. One of his conclusions was that the trend has been that domestic production is going down at the rate of 6 percent per year on the average and that after about five years that gives you a 2 million barrel per day deficit, rather than a 1 million barrel per day deficit. Why do you think the deficit will be 1 million rather than 2 million in the next five years?

Mr. **Easton**. Well, I think we see oil demand growth between now and 1995 growing at about 1 million barrels a day in the first part of that period, but only about 3 million for the whole period. The difference is in how we see capacity. I think Dr. Schlesinger sees less capacity in the world than we do in our projections.

The **Chairman**. I am talking about domestic production.

Mr. **Easton**. Oh, in domestic production, likewise, we forecast domestic production remaining higher than his scenario. We show domestic production declining less than his projected decline.

The **Chairman**. Well, I know, but I mean his is based on the now historic trend of 6 percent per year. Wherein do you disagree?

Mr. **Easton**. I can give you our projections, and then if you like I will invite my colleagues who do the modeling to tell you how we do this modeling, but the EIA projections show our production of all petroleum liquids by 1995 as close to 9 million barrels per day. His was much less than that.

The **Chairman**. Right. I mean, I am getting at the why, of wherein lies the difference? I mean, I know the numbers are different.

Mr. **Easton**. Do you want to come up, Cal, and see if we can explain? I should say also, Mr. Chairman, the figures I am using are from ETA's *International Energy Outlook 1990,* which will be released to the public about the end of this week.

With me is Calvin Kilgore from our Energy Information Administration, who has been responsible for preparing some of these estimates.

Mr. **Kilgore**. I think the difference, Senator, is that we see more positive effects from the increase in prices over the 1990s. That is one reason why I think there will be less of a decline in domestic production in the future than there has been in recent years.

The **Chairman**. I think you said, what, $28 a barrel in today's dollars by the year 1990?

Mr. **Kilgore**. By 2000.

The **Chairman**. By 2000?

Mr. **Kilgore**. By 2000 our base case has prices rising to $28 in real terms. In other words, in today's dollars.

The **Chairman**. Do you think that is enough to elicit all that domestic production?

Mr. **Kilgore**. Well, I think there are a number of prospects, with those increasing prices, that do look promising in the United States.

The **Chairman**. Where is that?

Mr. **Kilgore**. Especially in the off-shore areas—off-shore Louisiana and Texas I think are particularly promising over the next few years, and we believe that the prices we are projecting, which are increasing in real terms——

The CHAIRMAN. Well now, that is $28 a barrel by the year 2000. We are talking about the next five years.

Mr. KILGORE. We expect in the near term, first half of the 1990s, for instance, that prices will continue to oscillate on a month by month basis, but they will remain about where they are on average for the next two or three years. They will go up and down again on a month-to-month basis, but by about 1992, or 1993, we are going to see, at least on average, some fairly steady increases in the price of oil over and above inflation.

The CHAIRMAN. Well, I am trying to—Dr. Schlesinger painted, I think, a rather stark energy future as far as oil is concerned, and he said more than 2 million barrels a day domestic production will be done in the next five years. EIA says no, that is not correct, it will only be 1 million barrels a day, and I am wondering—I mean, your difference between Dr. Schlesinger is not the price of oil, is it?

Mr. KILGORE. It is not the price of oil alone; let me put some of these production declines into perspective a little bit. Over the past four years, we have had a decline, on a yearly basis, of an average of about 300,000 barrels per day. Now, I must point out, however, that between 1988 and 1989, it was a substantially larger decline. We had about a half a million barrel a day decline in that production.

The CHAIRMAN. Yes, well Prudhoe Bay just topped out when, the year before last or last year? The year before last.

Mr. KILGORE. Yes.

The CHAIRMAN. And the historic decline that projects 300,000 barrels a day while Prudhoe Bay is not declining would have to be increased by whatever Prudhoe Bay declines.

Mr. KILGORE. Right. I agree with that, and we are expecting a further decline in domestic production this year. Our own best estimates are something on the order of about 400,000 barrels per day.

However, as I said earlier, I do believe that we are going to see some additional production coming on line in the lower 48 States primarily in the off-shore areas that will tend to moderate what we saw last year and what we expect to see this year, and I think as the prices do continue to rise, that the incentives to bring that oil on will certainly have an effect.

The CHAIRMAN. So if you project 400,000 barrels a day decline this year times five, if that is the correct trend, then that is 2 million barrels a day deficit. About 2 million barrels deficit by the year 1995.

Mr. KILGORE. Our average decline over the 1990s, factoring in all of these factors—increased production in the Lower 48 largely driven by the increases in the prices that we are seeing here, and the decline in production from Prudhoe Bay in Alaska—is about 2 million barrels a day of crude oil production over the course of the decade.

The CHAIRMAN. Well, I must say I find it singularly unconvincing that you were right at 1 million barrels a day, instead of Dr. Schlesinger at 2 million a day, when last year it was 500,000 barrels a day decline and this year it is 400,000 barrels a day decline, and a simple mathematic projection says that you lose 2 million in five years, particularly my view of domestic oil markets would say you are not going to drill anywhere but off-shore Louisiana, and there are some promising things out there, but not that promising, I do not think. I hope they are, but——

Mr. **Easton**. As Mr. Kilgore mentioned, there are some new things that we see as coming on line. For example, from just one field alone, if we can get Point Arquello open, will add 60,000 barrels a day. So domestic activity is not nonexistent. There will be new activity coming on.

Secondly, the Deputy Secretary just announced a month or so ago our new initiative in the area of how we funding research and development in oil and gas fields. We are placing a large amount of our resource dollars into preventing the abandonment of wells so that we can take the 18,000 or so wells a year that are abandoned and, by putting money into research and technology that will enable more oil to come out of those wells, resume production to see some of this additional oil that Mr. Kilgore is referring to.

The **Chairman**. EIA projects that oil-fire electricity generation will increase by over 50 percent between now and the year 2000. What can we do to prevent utilities from becoming oil junkies once again?

Mr. **Easton**. We are doing a couple of things that we hope will deal with that Mr. Chairman. As you know, the Department is investing heavily in clean coal technology, and we think that clean coal technology, if it continues to be as successful as we hope, will continue to keep utilities turning toward coal, rather than abandoning coal, thereby creating a market for coal, especially clean coal that can meet environmental standards. That is one way we can stop the turn toward the increasing use of oil.

Secondly, a number of initiatives to undertake conservation and allow utilities credit for reduction in demand will indeed forestall some of that switching to oil. There are things that we see that need to be done that should slow this conversion over to oil, that has been a trend in recent years.

The **Chairman**. Thank you very much. Senator Murkowski?

Senator **Murkowski**. Mr. Chairman, thank you. I wonder if the Department of Energy has a position on the merits of opening up the Naval Petroleum Reserves—Elk Hills, I understand, is producing about 96,000 barrels a day—whether that could be increased if it were operated by the private sector, and the advantages and disadvantages of that? I gather we do not have a naval petroleum reserve number three. We have One, Two and Four. I do not know what happened to three.

Mr. **Easton**. I think number One is Elk Hills. I think Three may be Teapot Dome.

Senator **Murkowski**. I think that is Two. Four is the Naval Petroleum Reserve in Alaska. Nobody can seem to find the one in the middle, but nevertheless the question is specific. Does that offer you any relief?

Mr. **Easton**. I think our thinking is in line with yours, Senator. First of all, Elk Hills which the federal government owns with Chevron on a 78 to 22 percent basis is itself operated by private industry and the Department of Energy.

Included in our budget submission this year is the proposal to lease competitively the Naval Petroleum Reserves to the private sector, and put the revenues into the general fund, over its operation to the private sector and receiving $1.6 billion plus royalties in return. We think that the Naval Petroleum Reserves were a historical concept, but now we do not need that oil for energy security. The SPR has really taken the place of that.

Senator MURKOWSKI. Let me ask you one more question, and it is relative to the ANWR, recognizing that you have got a frontier area there. It is very, very costly to drill. You have no real assurance that there are reserves there of the magnitude that we would like to see, simply the best geological information that if a major discovery is found it might be found in that area, in that structure.

The dilemma of finding out with the government proposing some kind of contractual drilling as opposed to a lease sale obviously leaves one with a realization that there is no bonus bids if the government goes in, so you have potentially lost that revenue stream.

On the other hand, you have got a frontier area here, and there have been proposals that you would be better off to know and get the revenue from royalties as opposed to up-front, and that that would take the question out of it. You would know, as you know what the reserves are, theoretically, in a naval petroleum reserve, whether you can count on them or not, whether you want to bring them into development, as opposed to the dilemma we are in now.

My question is, would the Administration support any other scheme, other than the conventional bonus bids up front, if ANWR could be addressed on an alternative idea that would suggest that you just take the revenues in the conventional way as opposed to bonus bids?

Mr. EASTON. We as a Department testified before this Committee before when you voted out the ANWR legislation last year. We feel that ANWR should be explored. The testing and exploration should be done to see just what is there.

With that broad principle in mind, I think we would be amenable to any sort of approach that allows us to take a look at that development. Right now, nothing is happening, and we feel it is important, when we have a resource of that possible size, to try to corroborate what is the size, what is there, what could it produce, and what could it lend to our energy security? So we would study and look kindly toward any system that allowed us to do that.

Senator MURKOWSKI. Well, thank you. The only thing I would point out is that the Administration has, I think, in the 1993 projections from OMB about $2 billion coming from ANWR, bonus bids, and if somebody is going to work on a scheme to change the bid proposal and go royalties or something else, why, this senator would like to hear from them.

Mr. EASTON. Well, I think we in the Administration realize that something needs to be done before there are going to be any royalties of any type from ANWR. And, the first issue is to decide on a mechanism which will allow for the exploration of ANWR to determine what resources exist there?

The CHAIRMAN. Mr. Easton, I think this is the first time before the committee.

Mr. EASTON. It is.

The CHAIRMAN. We want to thank you for excellent testimony. You have been a very good witness, and we appreciate it.

Mr. EASTON. Thank you, Mr. Chairman.

The Chairman. Next we have two distinguished witnesses who have somewhat differing views of the world, and with their concurrence we would like to bring them up as a panel so that we can get the interplay between these two very good witnesses. The first is the Honorable Richard Schmalensee, member of the Council of Economic Advisers; and the second is our friend, Daniel Yergin, President of Cambridge Energy Research Associates in Cambridge, Massachusetts.

Gentlemen, welcome. We look forward to your testimony. We will begin with Mr. Schmalensee.

STATEMENT OF RICHARD SCHMALENSEE, MEMBER, COUNCIL OF ECONOMIC ADVISERS

Mr. Schmalensee. Thank you, Mr. Chairman. I am pleased to have this opportunity to appear before you today to talk about the world oil outlook. I must make clear at the outset that neither I nor the Council of Economic Advisers are in the business of generating independent forecasts of the oil market. Nonetheless, in preparation for this testimony I reviewed a number of current forecasts and a number of past forecasts.

What this process brought home to me most forcefully was the historic difficulty of forecasting the oil market, and I will give you just a couple of examples. My written statement has a few more.

Kenneth Arrow, a Nobel laureate in economics, said in 1980, "I'd be surprised if gasoline in 1983 is less than $2 per gallon plus whatever inflation Adjusted for inflation, gasoline prices were in fact less than half that in 1983 and are about one-third that today.

Another able and distinguished economist, Dr. Schlesinger, from whom you heard earlier, when he was Secretary of Energy in 1978 said, "What we face in the middle 1980s is a notional worldwide shortage of 5 million barrels a day." In the middle 1980s we had worldwide glut and price collapse.

I do not intend by choice of these examples to impugn the ability of either Dr. Arrow or Dr. Schlesinger but simply to point out that historically this has been a very difficult market to forecast and that oil——

The Chairman. If I may interrupt, I have stated that there has been no major trend in energy since I have been on the committee that I think has been correctly forecasted by anyone, at least that has been published. [Laughter.]

Mr. Schmalensee. I see no reason to dispute that based on my knowledge. It is a little discouraging, but it makes life interesting.

At any rate, the previous witnesses have indicated over the course of the coming decade, with differences as to timing and degree, that pressure on capacity would increase worldwide, that U.S. domestic production would decline, consumption would increase, the share of consumption coming from imports would likely rise, and OPEC's importance in the world market would likely increase. There seems to be general qualitative agreement there, although considerable quantitative dispute. As you suggest, they may well all be wrong.

It is worth pointing out that at least many forecasters suggest that real prices are unlikely to reach the levels we experienced early in the previous decade by the end of the century, and that forecasts that say OPEC's share of the oil market for market economies tend to show that share by the end of the century still below its levels in the early 1970s.

Before talking about the implications of these projections and the impact of the oil market on the economy, let me just say a little bit about Eastern Europe, one of the subjects the invitation letter mentioned and which other witnesses have addressed.

There are a number of conflicting and complementary trends that one can see. First, there is the difficulty of assessing the pace of reform and the pace of modernization of those economies.

Second, there is the fact that energy is used very inefficiently. East Germany leads the world in carbon dioxide emissions per capita. For instance, with an economy much less advanced than ours one expects increased energy efficiency; however, much of the energy in Eastern Europe comes from coal, and it is reasonable to expect a shift away from coal toward oil. The number of automobiles per capita in Poland is less than one-fifth of that in the United States, and one would expect an increase in oil demand on balance from Eastern Europe over time, the pace being highly uncertain.

Let me now turn to the impact of oil price changes and oil market developments on the economy as a whole. Here I am going to be relying heavily on the work the Council of Economic Advisers did as part of the interagency study of size options for the strategic petroleum reserve which was presented to you last month, I believe.

That effort identified two distinct adverse effects of increases in the price of oil, and it is important to keep them distinct. The first is what one might call a real income effect. That says, if the price of imported oil arises, we are simply poorer because we must send more goods abroad or sell more domestic assets to pay for any given level of imports. That is a direct income effect. It does not directly affect production and employment in the U.S. economy, although, depending on the policy response, there may be effects. The size of this effect is basically the level of imports times the size of the price change.

The second effect, which again is analytically distinct, comes from the difficulty that the economy has adjusting, the frictions involved in adjusting to changes in any major price, including the oil market price. The size of this effect depends not on the level of oil imports but on total oil consumption, since the difficulty is in adjusting to a price change.

The Troika agencies, Council of Economic Advisors, Department of the Treasury, and the Office of Management and Budget, after carefully reviewing the economic studies of the impact of oil price changes and analyzing some major econometric models of the U.S. economy, estimated that a 100 percent increase in oil prices for two quarters would cause a cumulative reduction in GNP over the following two to three years of between 1 and 2 percent of a year's GNP.

Because these frictional losses about which I am now speaking are temporary, a permanent doubling of the oil price would raise the frictional cost to only between 1.5 and 3 percent of a single year's GNP.

The **Chairman**. Would you like to pause here and comment on our charts? Did you see our charts?

Mr. **Schmalensee**. I have not yet. From where I was seated I was unable to see the front.

The **Chairman**. I will put up first the oil price and unemployment rate chart. They show, of course, that with the price of oil, unemployment rises.

The next chart is interest rates which rise.

The next is inflation.

The next is GNP growth, which goes counter to prices in oil.

Do you find in those charts, or in your own studies, this cause and effect relationship?

Mr. **Schmalensee**. There certainly is a major impact of oil price changes on the economy. I was just discussing some quantitative estimates of that effect.

It is important to keep in mind, however, that what we see on these charts reflects not just a direct effect but the effect of the policy response. For instance, in 1973–74 or in the Iran-Iraq shock, the sudden run-up in the price of oil presented monetary policymakers with a very unpleasant dilemma. They could either accommodate that increase, expand the money supply and allow more inflation, or they could resist the inflationary pressures and live with some unemployment. Different economies made different choices throughout the industrialized importing nations. All of them suffered pain.

Similarly, with the decline of the oil price in the last decade, monetary policymakers have a pleasant set of choices. They can expand output more rapidly with less inflation than otherwise. They can allow domestic output to expand more than it otherwise would with less risk of inflation simply because the declining oil price is tending to restrain domestic inflation.

What is difficult to disentangle is the direct effect of an oil price change versus the effects due to policy changes undertaken in response to it, but there is no question that oil price changes have a major impact on——

The **Chairman**. Well, to put it another way, if Dr. Schlesinger is correct that by the mid-1990s the oil import bill will equal all the other trade deficit put together. Would you agree with me that the outlook for GNP growth, inflation, interest rates, et cetera is very frightening indeed?

Mr. **Schmalensee**. May I answer that in two steps?

The **Chairman**. Sure.

Mr. **Schmalensee**. First I will talk about the trade deficit and then come back to precisely that question.

The trade deficit effects of an increase in the price of oil really come in two stages in the very short run over a period of months. An increase in the price of oil hits the trade deficit directly. Over the longer run, however, the trade deficit or the current account deficit is primarily determined by the relation between domestic saving and domestic investment.

What oil price changes do to that depends on how the increased revenues are spent, so you do observe, for instance, that the Germans and Japanese, even though they are much more dependent than we, have had quite rapid growth and that even in the 1970s we had a nonoil surplus, so that I would not judge the impact of an oil price increase on the U.S. economy by just pointing to the trade balance. I would certainly agree with the assessment that a major oil price increase in the next decade would have unfavorable implications for the U.S. economy, yes, sir.

The CHAIRMAN. Frightening.

Mr. SCHMALENSEE. Frightening I think is too strong. It depends on how strong an increase, of course.

The CHAIRMAN. If you agree with Dr. Schlesinger's projections of production, consumption, world oil supplies.

Mr. SCHMALENSEE. Dr. Schlesinger sees a sharp increase coming as there is a sudden awareness that demand is outstripping capacity. My view of the market allows a little more role for anticipations, and I would suggest that if indeed that is going to happen it will not happen overnight. It will happen over the course of some time if and as it becomes clear that his projection is correct.

I am reluctant to use "frightening". I would say it deserves serious concern.

Let me run quickly through the remainder of the prepared statement I have. I have a discussion in the written statement of the implications of the strategic petroleum reserve and a discussion of the economic analysis in the study that analyzed size options for that reserve, and it discussed the economic effects. As your staff has had that, I think it is most efficient to allow you to work from the written version.

Let me just say a little bit about policy. While it is certainly important to be concerned with domestic production, it is also important to recognize some of the lessons that the history of government intervention in the oil markets have taught us. We had oil import quotas in the 1950s and 1960s that, of course, encouraged more production from U.S. reserves than would otherwise have occurred.

In the 1970s, price and allocation schemes led to gasoline lines, and the entitlement system tended to subsidize OPEC. Efforts to subsidize commercial production of synthetic fuels in the 1970s and 1980s are a leading case study of the failures of industrial policy. If markets are allowed to remain free of unnecessary interference, consumers and producers can and do adjust to actual and expected price changes.

While it is important to encourage domestic production through tax incentives proposed by the Administration and by supporting research, it is equally important to recognize that energy security is a long-term problem. The United States should be careful not to compromise future energy or economic security. Thus, we should be careful not to lower economic growth by excessively costly programs to replace oil imports and should avoid encouraging faster depletion of our oil reserves than would be called for by the market.

Thank you, Mr. Chairman. Sorry to have taken a bit more time than I should have, and I am, of course, ready to answer any additional questions you may have.

[The prepared statement of Mr. Schmalensee follows:]

STATEMENT OF
RICHARD SCHMALENSEE
MEMBER, COUNCIL OF ECONOMIC ADVISERS
BEFORE THE
SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES

March 26, 1990

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I am pleased to appear before you to discuss the World Oil Outlook. Since you will be hearing today from a number of experts on the world oil market, I will follow the dictates of the law of comparative advantage and concentrate on the implications of developments in that market for the U.S. economy.

THE DIFFICULTY OF LONG-TERM OIL MARKET FORECASTS

It is important to recognize at the outset that forecasting oil market developments is extremely difficult. History makes this abundantly clear. For instance, the CIA expected in 1977 that demand for OPEC oil would reach 47 to 51 million barrels/day (MMB/D) by 1985. The actual figure was 17.2 million barrels. President Carter said in 1979 that "prices are going to rise in the future no matter which party occupies the White House, no matter what we do." Prices fell for five straight years from 1981 to 1986.

Even able and distinguished economists have had trouble. Kenneth Arrow, a Nobel laureate in economics, said in 1980, "I'd be surprised if gasoline in 1983 is less than $2 per gallon plus whatever inflation adds." Adjusted for inflation, gasoline prices adjusted for inflation were in fact less than half that in 1983 and are about one-third that today. Another able and distinguished economist, Dr. James Schlesinger, when he was Secretary of Energy in 1978, said, "What we face in the middle 1980s is a notional worldwide shortage of 5 million barrels a day." In the middle 1980s, we had a worldwide glut and price collapse.

Finally, Sheik Yamani, then Saudi Arabian Oil Minister, said in 1979 that as a result of "irreversible physical shortfalls in supplies," oil prices could rise by a factor of 3 or 4 by 1988. In fact, real oil prices in 1988 were less than half of those in 1979.

If the Council of Economic Advisers had been in the business of forecasting oil prices, it would no doubt have made similar errors. The point of these examples is that oil demand, supply, and price are difficult to forecast. If there is a pattern to past forecast errors it is a tendency to under-estimate the long-run responsiveness of both demand and supply to price. But the more important lesson of history is that one must recognize the high uncertainty that attaches to any forecast of oil market developments beyond the very short run. It is therefore with considerable humility that I discuss projections for the 1990s.

THE OIL MARKET OUTLOOK

It is important to separate the short-term from the long-term outlook. There appears to be substantial excess capacity in the oil market currently and little upward pressure on prices. Taking a longer view, a gradual shrinking of world excess capacity may produce rising real oil prices, by the end of the decade. It is interesting to note, however, that forecasters seem generally to agree that inflation-adjusted prices are unlikely to reach 1985 levels, let alone 1981 levels, by the end of the decade.

U.S. domestic oil production is falling, while consumption is rising, so that the share of consumption provided by imports is likely to rise. As the West Germany and Japan illustrate clearly, however, even near-total dependence on imported oil is not inconsistent with strong economic growth.

For the world as a whole, the pattern of proven reserves and new discoveries point to gradual increases in OPEC's market share. The recent study of SPR size options included a projection that OPEC's share of the oil market for the market economies will rise from 41 percent in 1990 to 53 percent in 2000. This would still be substantially below OPEC's peak share of 68 percent in 1974.

THE IMPACT OF CHANGES IN EASTERN EUROPE AND ENVIRONMENTAL LEGISLATION

Before considering the economic implications of these long-term projections, let me discuss the impact of two significant potential developments on the world oil market: the movement of Eastern Europe and the Soviet Union towards market-oriented economies and possible Clean Air legislation.

The impact of changes in Eastern Europe and the Soviet Union is difficult to assess, even if one makes the hopeful assumption that market-oriented reform will be widespread and successful. Overall, energy usage in the Eastern European countries is extremely inefficient by world standards. One indicator is the high energy intensity of production in these countries, although this measure is somewhat skewed by the fact that central planners have tended to stress heavy industry. Still, one might expect economic modernization to lead to less energy usage overall.

Modernization is also likely to change the pattern of energy usage. Eastern Europe now relies less on oil as an energy source than do OECD member nations. Coal currently accounts for 80% of Poland's energy needs, for instance. Even if these countries use oil more efficiently as they reform and develop, oil consumption is likely to increase over the medium to long run. In particular, one can expect market-oriented development to lead to sizable increases in automobile usage. In 1987, for instance, the U.S. had roughly 5 times as many cars per capita as Poland.

Most crude oil used in Eastern Europe (85 percent of the oil used in Poland, for instance) is imported from the Soviet Union. Soviet oil is priced at a 5-year moving average of world prices, and there is also a significant component of barter in "convertible rubles" that makes the net import price difficult to compare to world prices. When oil prices dropped in 1986, Soviet export prices exceeded world prices. More recently, they have been below world prices.

Market-oriented reform is likely to raise energy prices in these nations, which would slow the growth of energy consumption, and a rationalization of prices will probably lead to a shift away from coal and toward electricity and gas. Governments in Eastern Europe have subsidized energy consumption in the sense that prices are far below cost. However, since the entire price structures of these nations are distorted, it is difficult to infer the net effect of comprehensive movements toward market-based pricing.

The impact of economic and political change on Soviet oil production seems, at least to a non-expert, to be highly uncertain -- at least as uncertain as the future of reform in the Soviet Union. Since it is even unclear whether the changes in the Soviet Union and Eastern Europe will increase or decrease oil consumption, projecting the net impact on the world oil market in the next decade is exceptionally difficult.

While it seems likely that the Clean Air Act will be significantly amended this year, it is at least as difficult to forecast the specific provisions that Congress will ultimately enact as to forecast future oil prices. It seems likely that U.S. refinery costs will be increased to some extent. A significant clean fuels program would require substantial capital outlays throughout the production and distribution system, but it does not appear likely that the effects of the clean fuels programs that have been discussed recently would produce changes in U.S. production or demand that would have a major impact on world prices or on U.S. import dependence.

THE EFFECT OF HIGHER OIL PRICES ON THE ECONOMY

As part of the interagency analysis of strategic petroleum reserve (SPR) size options that was completed last month, the Troika agencies (consisting of the Council of Economic Advisers, the Department of the Treasury, and the Office of Management and Budget) performed a study of the impact of higher oil prices on the economy. Increases in oil prices have two distinct negative effects on the overall economy.

First, an oil price increase causes a loss of real income for consumers and a gain for producers. Since the United States is a net importer, the loss to the economy as a whole exceeds the gain. Put more simply, if the price of imported oil rises, we are poorer because we must either shift more exports abroad or attract more capital from abroad to pay for any given level of imports. While our living standards would fall because of this effect, there are no direct consequences for domestic production or employment. The size of this first effect is approximately the level of imports times the size of the price change.

Second, the economy incurs temporary frictional losses of output and employment whenever prices change in any important sector, such as the oil market. It is critical to understand that the size of this effect depends on the speed and size of the price change and on total oil consumption, but not on the level of oil imports. The Troika agencies, after carefully reviewing the economic studies of the impact of oil price changes and analyzing some major econometric models of the U.S. economy, estimated that a 100 percent increase in oil prices for two quarters would cause a cumulative reduction in GNP over the following 2-3 years of between 1.0 percent and 2.0 percent of annual GNP. Because frictional losses are temporary, a permanent doubling of the oil price would raise the cost only to between 1.5 percent and 3.0 percent of a single year's GNP.

In addition, increases in the price of oil are likely to have an adverse effect on the U.S. trade balance in the short run, though the size of the effect depends critically on how oil exporters elect to spend their increased receipts and on how the Federal Reserve reacts. At one extreme, if oil exporters spend all their higher receipts on U.S. exports, the U.S. trade balance would not change at all. At another extreme, if all these funds were invested in the U.S. and the Fed held U.S. real interest rates steady, the fall in the trade balance, at least in the very short run, would be exactly equal to the increased cost of oil imports. In more plausible scenarios, the dollar and domestic oil consumption would fall somewhat, U.S. exports would rise somewhat, and the short-run decline in the trade balance would be somewhat less than the increased cost of initial imports. It is important to understand, however, that the U.S. current account balance is basically determined by the relation between domestic saving and domestic investment, and the effects of oil price changes on these aggregates are difficult to predict. West Germany and Japan have managed to run persistent current account surpluses despite importing essentially all the oil they consume.

THE EFFECT OF INCREASED OIL IMPORTS ON THE ECONOMY

A reduction in domestic production leading to an increase in oil imports involves a real loss to the economy. The loss to the United States of the extra oil imports is substantially less than the dollar value of those imports, however since the resources used in producing the domestic oil would be freed for other uses. Moreover, it is important to recognize that the economy as a whole is always better off importing competitively priced oil than using more costly domestic production.

Domestic producers cannot take into account the impact their decisions in aggregate have on world oil prices. Nor can they consider the effect of their exploration and production on the vulnerability of the U.S. economy to an oil supply disruption. For this reason, the Administration has proposed several incentives for domestic oil exploration and production, including encouraging new enhanced recovery techniques. Adopting the Administration's proposals would help reduce U.S. demand for imports and thus help restrain OPEC pricing behavior. The Administration is also addressing a market failure by funding numerous basic and applied research projects in energy. Private firms typically cannot capture the full benefits that basic and applied research yield for the economy as a whole.

A major source of concern about the recent increase in the importance of oil imports has been the fear of increased vulnerability to an oil supply disruption. While some concern is of course warranted, the danger is easy to exaggerate in light of the probable state of the oil market over the next decade and the consequences of a major disruption in the unlikely event that one should occur. This last point is important and deserves elaboration.

WHY AN OIL SUPPLY DISRUPTION IS LESS LIKELY

There have been a number of important changes in the world oil market since the 1970s that tend to decrease the probability of a severe petroleum supply disruption. These include:

- OPEC members now recognize that if oil prices rise too far, the market responds with conservation, fuel-switching, and increased production by non-OPEC petroleum producers. Both demand and supply have shown themselves to be price-sensitive in the medium and long terms, and the end result of a sharp price increase may well be less revenue, particularly for the Persian Gulf producers.

- Some members of OPEC have invested substantial capital in refining and downstream petroleum distribution facilities in the United States and Europe. A supply disruption would lower the returns on these investments.
- The United States has eliminated the ineffective, indeed counterproductive, Government allocation and price controls put in place during the 1970s and now relies on market mechanisms. This has resulted in a much more efficient allocation of oil that rapidly adjusts to changes in prices.
- There is currently substantial unused oil production capacity in OPEC, capacity that may come into use in the event supplies are disrupted. In addition, OPEC members are expected to increase capacity by 4 to 6 million barrels per day by around the mid 1990s. This capacity would provide more than enough capacity to meet projected increases in demand. Even though much of the capacity will be in the Middle Eastern countries, it is important to recall that in 1973-74 and again in 1978-79, there was additional production from unused capacity by some OPEC countries.
- The United States, West Germany, and Japan have accumulated about 1 billion barrels of strategic petroleum reserves or enough to offset the full amount of the most severe disruption of the 1970s (1978-79) by 1.5 times. The U.S. and Japan continue to increase stocks, and these stocks will deter those who may consider an embargo.
- Petroleum futures markets have increased market efficiency in reacting to changes in the demand, supply, and distribution of petroleum and petroleum products throughout the world.

Once again, the world is experiencing increase in aggregate petroleum demand and U.S. imports are rising. However, there are many reasons to be optimistic about future oil markets and prices. The changes that have occurred since the 1970s are on balance positive, leaving the U.S. far less vulnerable than it was in 1973.

THE IMPACT OF AN OIL SUPPLY DISRUPTION

World and U.S. energy security preparedness is at a much higher level now than it was in the 1970s, and that state of affairs should continue through this decade. Should a massive oil disruption occur, however, even though such an event is thought to be highly unlikely, there would be price increases, but the economy could ride it out without major dislocations.

The projections used in the 1990 SPR size study showed that market economy demand for oil would likely remain less than 55 MMB/D through the year 2000, close to the 53 MMB/D at the time of the Iranian Revolution disruption, which at 3.7 MMB/D was the largest disruption of the 1970s. The disruption associated with the 1973 Arab-Israeli war was far smaller, at 1.6 MMB/D. The large price jump associated with the 1973 disruption was due in part to the lack of substantial offsets such as excess capacity or strategic stocks. By comparison, initial prices effects of the 1979 disruption (which was larger in absolute size and as a percent of consumption) were partially offset by a 2.5 MMB/D surge in Saudi Arabian production. The events of the 1970s show that offsets to disruptions are important for avoiding large price increases.

The 1990s will be characterized by large offsets to any oil supply disruptions, making politically-motivated disruptions less likely and raising the threshold for any disruption to have significant economic effects. At current maximums, the U.S. SPR can be drawn down at 3-3.5 MMB/D for at least 6 months, foreign strategic stocks can be drawn 2-2.5 MMB/D, excess capacity could add 5-6.5 MMB/D, and fuel switching could contribute another 0.5 MMB/D. Total potential offsets sum to 10-13 MMB/D. It would take an unprecedented disruption of enormous size to overcome these offsets.

In the event of a major disruption, there would be an initial runup in prices. But, as the U.S. SPR and foreign strategic stock drawdowns were announced, and to the extent that excess capacity comes on line, prices would moderate, limiting adverse economic effects. For example, a net disruption of 5 MMB/D -- that is, one that had a 5 MMB/D impact even after all the offsets discussed above have come into play -- that lasted for six months would likely cost the U.S. about 1.5 percent of a year's GNP even at the level of imports projected for the year 2010. This estimate includes both the real income and frictional effects discussed above. Moreover, this loss would be spread out over 2-3 years. Such a disruption would not tip the economy into a recession, since the underlying long-run growth rate of the U.S. economy is around 3.0 percent per year.

While the history of the 1970s may suggest that oil supply disruptions have more substantial effects than these estimates mply, studies of the oil shocks of the 1970s point to the mportance of other forces. Many have argued that macroeconomic olicies exacerbated the effects of the two oil shocks, and price nd allocation controls were the primary causes of gasoline lines nd energy shortages.

THE EFFECT OF GOVERNMENT INTERVENTION IN THE OIL MARKET

In assessing the impact of oil market trends, it is also important to consider the consequences of government intervention in the oil market. Direct government interference with market forces was a self-inflicted policy disaster in the past. Oil import quotas encouraged the draining of America's oil reserves in the 1950s and 60s when world oil was inexpensive and supply disruptions were improbable. In the 1970s, price controls and allocation schemes led to gasoline lines and administrative snarls, and the entitlements system subsidized OPEC. Efforts to subsidize commercial production of synthetic fuels in the 1970s and 1980s are a leading case study of the failures of industrial policy.

If market are allowed to remain free of unnecessary regulation, consumers and producers can and do adjust, not only to actual price changes, but also to expectations about the future. Expected price increases are built into drilling and production decisions. Forecasts of future price changes or reductions in domestic production do not mean that the market has failed or that the government should override market decisions.

In assessing the impact of increased oil imports on energy security, we need to develop responses appropriate to the risk. After careful analysis of both economic and strategic factors, the Administration has determined that a 750 million barrel Strategic Petroleum Reserve provides ample protection against the economic impact of even major disruptions. By any standard, it represents a more substantial investment in insurance than any of our allies have made.

While it is important to encourage domestic production through the tax incentives proposed by the Administration and by encouraging research, it is equally important to recognize that energy security is a long-term problem. All else equal, higher current production tends to reduce the reserves available in the future. The United States should be careful not to compromise future energy or economic security. Thus we should not lower economic growth by excessively costly programs to replace oil imports and should avoid encouraging faster depletion of our reserves than would be called for by the market.

The CHAIRMAN. Thank you very much, Mr. Schmalensee. Let us hear from Dr. Yergin.

STATEMENT OF DR. DANIEL YERGIN, PRESIDENT, CAMBRIDGE ENERGY RESEARCH ASSOCIATES

Dr. YERGIN. Thank you, Mr. Chairman. It is really an honor to have the opportunity to appear at this hearing. It is a very timely hearing. The reason it is timely is that the world oil market is entering a new era. This has happened several times in the past two decades. The fundamentals and direction have changed, and these emerging changes will, as we have already discussed this morning, have significant implications for price and security of energy supplies.

There are three major sources for the shift that stand out. The first is that U.S. oil production is falling like the proverbial rock. It has dropped 1.8 million barrels per day or 17 percent since the beginning of 1986. I think the beginning of the down turn on the Alaskan North Slope may be one of those significant turning points.

As the Chairman observed this morning, the falling production combined with rising demand means rising imports, and it makes the question of the trade balance loom very large indeed. At current prices, each 1 million barrels a day of additional imports means an additional import bill of $7 billion.

The second significance source of change is the political and economic shifts in the Soviet Union and Eastern Europe. It has meant a Soviet oil production drop of somewhere between 300,000 and 400,000 barrels a day of oil in 1989 with similar declines expected for 1990 and big questions about Soviet oil export levels, and the Soviet Union is a significant exporter in Eastern European energy demand.

We have all learned two Russian words, perestroika and glasnost. To them we have to add a third, bezporyadok, which means disorder. The question of disorder in the Soviet economy in the Soviet political system can have grave implications around the world.

To some degree the Soviet energy establishment is disordered today. As Secretary Schlesinger pointed out, the upheavals is Aizerbijan are a direct threat to the service industries that support the Soviet oil and gas industry, and on top of that last year the Soviets moved to substantially decrease their investment in energy, oil particularly, feeling that they have been overinvesting since the eras of Brezhnev.

The third important factor of change in the world oil market really arises from the continuing and somewhat surprising strength of the East Asian economies which is translated into vigorous demand for energy and for oil. We have already had a brief discussion this morning of the perils of forecasting. Let me just give you one example.

In 1987 the view in the Japanese electric utility industry was demand for electricity in Japan would rise by 2 percent in 1988, only one year away. Instead, it rose by 6 percent, and it is that kind of demand which translates into higher oil use.

Other features of the energy situation are also noteworthy. Not only is oil production capacity being used at a high rate but also oil transportation, refining and electric generation in the U.S. and around the world are operating at high rates of utilization.

I think the changes in the world oil market that we are seeing today from the period 1985 to 1990 are not as dramatic, of course, as those which took place between 1980 and 1985, but they are still very significant. The security margin so laboriously built in the second half of the 1970s and early 1980s is now shrinking.

These current circumstances provide reason to take a fresh look at the dynamics of the world oil market as provided for in these hearings at the determinance and meaning of energy security for the 1990s, the vitality and prospects of the domestic U.S. energy industries, and something that we have touched on briefly this morning, sources of capital for energy investment.

One other factor which is very important is the significant and growing interaction between energy markets and environmental policies. We have just completed a major survey of the attitude of the American public towards energy and environmental issues that underscores the degree to which a broadbased environmental consensus has developed that cuts across traditional political, ideological and demographic differences.

Two points. One, two-thirds of the public say that we can have both economic growth and a cleaner environment, but when forced to choose at least in a period where we now have high, relatively good economic growth, three-quarters said they would choose the environment over economic growth.

These broadbased environmental concerns will affect our energy situation in four ways. by restricting options for various forms of energy development; by providing a new rationale for conservation, by motivating shifts in fuel choice; and by encouraging technological innovation.

All of these factors that we have talked about come together to mean a shrinking security margin and upward pressure on oil prices. Now one of the big unknowns is, of course, economic growth. If economic growth rates continue at recent levels it will mean greater pressure on energy supplies sooner.

I would like to remind you all that in October 1973, the time of the first oil crisis, there was a synchronized economic boom in the industrial world. Conversely, if we do have an economic slowdown, that will mean that the pressure is pushed off.

It all adds up to the fact that the balancing mechanism is OPEC and, has been discussed this morning, suddenly attention has come to focus a great deal on what is OPEC capacity.

Even among the OPEC countries themselves there is much debate about what physical capacity is, but the consensus number is around 27 million barrels per day. That suggests today that OPEC is operating at 85 percent capacity, which is high and does not leave a great margin for accidents and the unexpected or, indeed, for further rises in the demand over the next few years.

These countries are now focused too much on security demand for themselves in building long-term links. The orientation between producers and consumers is quite different than in the 1970s. Nevertheless, with a market operating at that higher capacity level, it is a market that is more accident-prone. It need not necessarily be an event in the Middle East, although it could be. It could be a disturbance in Soviet oil production, or a serious environmental problem, or even, as we saw last winter, it can be the weather.

Thirdly, the nature of management of risk within the energy industries has changed. Owing to the pressure of financial markets and energy markets over the past few years, the various stages of the energy supply markets companies are more taut, with less cushion, and thus management of risk may end up more in the marketplace than within companies.

We have a question mark over what kind of conservation potential is ahead in the future, and as I said, eyes have now really turned to this question of capacity additions in OPEC—who will add that capacity, who will pay for it, how will it be paid for, and when?—and I think some of the discussion this morning has really revolved upon the timing and the extent of those additions.

I think that as we look within our own country, we see that there is much increasing emphasis that is going to be placed, or try to be placed, on natural gas. The critical question for natural gas in the 1990s will be whether the production capacity and transmission infrastructure will be in place to meet the additional demand without causing major price shocks or supply curtailments in that market.

Finally, let me add, and again I think it has been prefigured in the discussion this morning about tankers, that environmental needs as related to energy and energy supply and transmission needs themselves, will be competing for capital investments in the 1990s. The effort to recognize these emerging environmental mandates, along with growing constraints on worldwide oil and energy capacity, will we suspect, among other things, elicit a new rationale for conservation and efficiency.

[The prepared statement of Dr. Yergin follows.]

Cambridge Energy Research Associates

"WORLD OIL OUTLOOK"

TESTIMONY

presented to the

SENATE COMMITTEE ON
ENERGY AND NATURAL RESOURCES

by Dr. Daniel Yergin
President, Cambridge Energy Research Associates

March 26, 1990

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Introduction

The world oil market is entering a new era. As has happened several times in the past two decades, the fundamentals and direction have changed. These emerging changes will have significant implications for price and security of energy supplies.

Three of the most important sources for the shift are:

- The continuing sharp fall in U.S. domestic oil production, which has dropped 1.8 million barrels per day (mbd), or 17 percent since the beginning of 1986.
- The rapidly changing political and economic structure of the Soviet Union and Eastern Europe has contributed to a drop in Soviet oil production of 0.3 to 0.4 mbd in 1989, with similar declines expected for 1990 -- and larger questions remaining concerning Soviet oil exports and Eastern European energy demand.
- The continuing strength of the East Asian economies, which has translated into vigorous demand for energy and, in particular, for oil.

Other features are also noteworthy. Not only is oil production capacity, being used at a high rate, but also oil transportation, refining, and electricity generation in the U.S. and around the world are operating at high rates of utilization.

The changes in world oil markets in the half decade between 1985 and 1990 are certainly not as striking and dramatic as that between 1980 and 1985 -- that is, from the "Second Oil Shock" that followed the fall of the Shah of Iran to the eve of the great price collapse. But still these current changes are of great importance. They indicate that the world oil market is on a track in which risks become greater. It does not necessarily mean that there is a serious crisis ahead, but certainly the market will become more vulnerable to economic and political developments as well as to physical accidents and disruptions. The "security margin," so laboriously built in the second half of the 1970s and early 1980s, is now shrinking. These current circumstances provide reason to take a fresh look at the dynamics of the world oil market, as provided for in these hearings, and at the determinants and meaning of energy security for the 1990s, the vitality and prospects of the domestic U.S. energy industries, and the sources of capital for energy investment.

In addition, we should expect very significant interactions between energy markets and environmental policies. We have just completed a major survey of the attitude of the American public toward energy and environmental issues that underscores the degree to which a broad-based environmental consensus has developed that cuts across traditional political, ideological, and demographic differences.* Strikingly, two-thirds of the public say that we can "have both economic growth and a cleaner environment." But, when forced to choose, three-quarters said they would choose the environment over economic growth. It should be noted that this movement is at least as strong in Western Europe. The broad-based environmental concerns will affect our energy situation in four ways: by restricting options for various forms of energy development, by providing a new rationale for conservation, by motivating shifts in fuel choice, and by encouraging technological innovation.

In looking at these issues, we need to keep in mind the broad dimension of energy security.** The objective of energy security is to assure adequate, reliable supplies of energy at reasonable prices and in ways that do not jeopardize major national values and objectives. It is not very difficult to conceive of the kind of event that could trigger a crisis. Indeed, the question is not whether there will be events that could threaten energy supply -- for surely there will, be they political, military, or technological -- but rather how resilient energy markets will be and how effective energy security measures will prove. There is much that is uncertain about how markets will develop in the 1990s, ranging from the level of non-OPEC supply, to economic growth in both the developed and the developing world, to technological developments that can affect energy consumption, supply, and transportation. To all that, we must add the continuing interaction between environmental considerations and energy markets.

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*Cambridge Energy Research Associates, Special Report, *Energy and the Environment: The New Landscape of Public Opinion.*
**Daniel Yergin, Energy Security in the 1990s, *Foreign Affairs*, Autumn 1988.

The Decline in U.S. Production

In general, non-OPEC supply and production capacity has been resilient since the price collapse. This is the result of stability in North Sea production (although accidents there have disrupted production), combined with increasing output from a disparate group of developing countries, ranging from North and South Yemen to Angola, Malaysia, and Colombia.

The great exceptions are the United States and the Soviet Union -- the world's two largest producers of oil.

Production of U.S. crude oil and liquids combined by the end of 1989 fell to 9.1 mbd, more than 700,000 barrels per day lower than the average for 1988, and 1.8 mbd lower than the early 1986 pre-collapse level -- a fall of 17 percent (during the same period, crude oil alone fell 1.6 mbd, to 7.6 mbd). This decline occurred because of the fall in output in the traditional producing regions of the Lower-48 states, and because 1989 was the first year of significant declines in Alaskan oil output (Alaskan output today is 0.1 mbd less than at the beginning of 1989). We expect these trends to continue in 1990, with production dropping another 400,000 barrels per day to 8.9 mbd (see Table 1).

Table 1

The Additional Call on the World Oil Market
1985-1990
(mbd)

	U.S. Production	Demand	
		U.S	Total Asia
1985	10.6	15.7	10.7
1986	10.3	16.3	11.1
1987	10.0	16.7	11.6
1988	9.8	17.3	12.4
1989	9.3	17.3	13.0
1990	8.9	17.4	13.5
Change 1985-1990	(1.5)	1.7	2.8

Source: Cambridge Energy Research Associates.

At the same time, U.S. oil demand has been going up, though at a rather moderate rate. In 1989, it was [illegible] mbd, an increase of 1.5 mbd over 1985. There is a widening gap to be filled, and it is being filled by imports, which are now back to the high levels of 1977 through 1979. On a net basis, between 42 to 45 percent of our total demand has been met by imports in recent months, roughly the same level as in 1979. Our import dependency had been as low as 27 percent in 1985.

U.S. refineries have been running at higher levels each year since 1985; in 1985, the average annual utilization rate was 78 percent. By 1989, the average rate had increased to 87 percent. Peak utilization rates topped 90 percent for the first time during the summer and early fall of 1989. The U.S. refining industry is increasingly operating at or near capacity for longer periods of time. As a result, the market will become more sensitive, at least in the short run, to any problems in the refining industry. In addition, increased imports -- over and above those required to meet rising demand and falling crude production -- will be required during times of refinery operating difficulties.

The cost of this continuing decline in production and growth of imports can be staggering, even if we put aside the associated energy security concerns. Our oil import bill is currently running at around $50 billion per year. An incremental million barrels per day of oil imports add approximately $7 billion to the trade deficit, requires as many as 40 incremental oil tankers at a cost of as much as $80 to $90 million each, and requires large additional investment in the rest of our import infrastructure. And, of course, it implies a continuing increase in tanker traffic, with the ongoing concerns there.

All of these factors give impetus to the question of how to slow, forestall, or offset domestic oil production declines. This, however, may not be easy to do and certainly will not be costless. After all, the U.S. is a mature and expensive oil province. One reason that imports are rising is that they are cheaper than the cost of developing new domestic oil production. New technologies may change that equation, but for the time being the U.S. oil industry is still very depressed. In

1989, three years after the 1986 price collapse, the rig count in the U.S. dropped to 869, the lowest since they started recording those numbers. While we expect these numbers to improve over the next few years, the principal focus of this incremental exploration will be on natural gas. One-half of the exploration and production budget by large U.S. oil producers is now earmarked for international exploration, as compared with less than one-third historically. Add to these structural shifts the new emphasis on environmental controls, and a second major layer of capital requirements for the domestic oil industry is building up. For the next few years we may have to consider declining U.S. production and rising import levels as a fact of life -- although the rates of both will be most significant.

But one of the most important questions is how these imports fit into the global context. There is essentially only one world oil market, and price pressures and changes in supplies from a given region, whether decreases or increases, will reverberate throughout the market and affect all consumers, whether they draw heavily from that specific region or not. Thus, the question of U.S. oil imports needs to be examined in the context of the overall market. This leads us to look at two other influences on the world oil market and then at the overall balance of supply and demand.

Changes in the Eastern Bloc

The second major force that may change the balance of world energy supplies and the focus of our energy polices is the dramatic political upheavals that are occurring in the Soviet Union and Eastern Europe. Amid the marvel of political change, however, is the economic depression and chaos within the Soviet economy.

We have learned two Russian words, *glasnost*, meaning "openness," and *perestroika*, meaning "restructuring." We need to add a third to our vocabulary -- *bezporyadok*, or "disorder." The fear of disorder is a long and powerful theme in Russian history, and one that impels responses. Today, in addition to the dramatic political questions in the Soviet Union, we observe serious disorder in the economy of the U.S.S.R., which, in whatever way it is resolved, will have wide international implications.

In terms of what we are considering today, this disorder can directly and indirectly affect the Soviet energy sector, which in turn will have significant impact on the world oil market. After all, the Soviet Union is not only the world's largest oil producer; it is also a significant exporter to the West, larger than Mexico and on the same scale as Kuwait. Moreover, oil and gas exports to the West provide about 70 percent of the Soviet Union's hard currency exports.

In the near term, the Soviets' emergency economic plan signals a major shift in energy policy, which could lead to declines in oil and gas production and possibly exports. The Soviets have recently moved to reduce investment in their oil sector. On the surface it seems odd that the Soviet Union would reduce investment in the very sector that produced the country's major source of hard currency earnings. But, since the mid-1970s, investments in the energy sectors have accounted for more than 70 percent of the growth in Soviet industrial investment. This level of commitment to energy investment is choking off Gorbachev's economic modernization program. The result of this policy shift, however, will be a continued fall in oil and coal output and a possible stagnation in the growth of electricity output and natural gas production.

How severely this policy shift results in a decline in net Soviet oil exports depends on whether and how fast the Soviet economy grows, and whether any of the new objectives in energy conservation can be realized. It may also depend on the functioning of the Soviet oil service and equipment industry, which is centered around Baku in troubled Azerbaijan. The service sector has been hard hit by the unrest and strikes in the region, and over the next few months we could see the effects of the disorder on production. While the long-term outlook for Soviet oil exports remains cloudy, declines in the near term appear unavoidable. Indeed, Soviet oil production could fall by as much as 300,000 to 400,000 barrels per day during 1990, after declining by a similar amount in 1989.

Another layer of complexity is added by the rapid changes in Eastern Europe. There remains a very real question as to whether the Soviets will be willing or able to maintain their current commitment of oil and gas exports to these nations at favorable prices. They have already begun to cut back on oil supplies to those countries and to insist on payment in hard currency. It seems likely that those countries will have to turn increasingly to the world market for incremental energy supplies. This may add a new set of strains as these nations increase their reliance on oil and natural gas for economic growth and, most importantly, to help address their very severe pollution problems.

Overall, the disorder and uncertainty in the Soviet Union and Eastern Europe is generating a persisting uneasiness and uncertainty in the world oil market, and affecting the way that various actors in the market behave.

Growth in the Far East

A third significant force is the rapid oil and energy demand growth in the Far East and numerous parts of the developing world. Its continuation will be a dynamic factor in the 1990s. Economic growth has been higher these past few years than expected, especially in the Far East. In 1988, Japan grew at 5.7 percent and in 1989 at 4.9 percent. At the same time, the oil/GNP ratio has been moving up. The result has been higher growth in oil demand. Growth in oil demand over the past several years in Japan has been 4 to 5 percent per year. In developing Far East countries such as South Korea, Thailand, Malaysia, and Taiwan, the combined growth is running between 6 and 10 percent. Perhaps even more surprisingly, in many of these nations the growth in oil consumption will exceed the growth in GNP. This pattern may well continue for several years as the development of infrastructure combined with a rapid increase in private vehicle ownership in these countries is driving these gains in oil demand. The net result is that by the mid-1990s, the import of crude oil and products to the Far East from outside the region may increase by 2 mbd or more.

The Far East may also see a boom in liquefied natural gas (LNG) trade due to its environmental advantages and also the need to diversify fuel supplies. The need to develop gas and electricity grids and other infrastructure in the Far East will place a major strain on energy and capital markets in the 1990s.

A Tighter Market

The combined forces of declining production in the U.S. and the Soviet Union and rising oil demand, particularly in the Far East, equate into a shrinking security margin in terms of global oil production and capacity, and places more upward pressure on oil prices. If economic growth rates continue at recent levels, it will mean greater pressure on the energy supply sooner. The November 1973 crisis occurred at a time of synchronized economic booms in the industrial world. Conversely, any economic slowdown will tend to reduce pressure on energy markets.

The balancing mechanism is OPEC. The world's demand for OPEC oil has risen sharply, more rapidly than most decision-makers even in OPEC might have expected. OPEC output has risen from 16.1 mbd in 1985 to 21.7 mbd in 1989. Currently, it is averaging 23.3 to 23.5 mbd. At this moment, our expectation that the "call" on OPEC oil for 1990 will be around 23 mbd. There is a good deal of debate as to what OPEC capacity is, but 26 to 28 mbd is the generally accepted range, with 27 mbd the consensus number. This suggests that OPEC is operating at roughly 85 percent capacity -- which is high and does not leave a great margin for accidents and the unexpected, or indeed for further rises in demand over the next few years.

Five points emerge from this observation:

1. OPEC: Security of Demand. The orientation of most OPEC countries towards their customers, primarily in the U.S. and the other industrial countries, is quite different going into the 1990s than it was going into the 1970s. The emphasis today for the exporters is on "security of demand" -- long-term markets, where demand will be met by reliable suppliers. The exporters saw their markets shrink before their eyes in the

1980s, and they do not want to repeat that. Thus, a number of exporters currently see their interests best served by "moderate," rather than high prices.

2. The Market: Accident Prone. A tight market, however, is one vulnerable to shocks. Customarily one looks at the Middle East for such shocks, but they could arise elsewhere as well, such as a perturbation in Soviet oil production or a serious environmental problem. The market is also exposed to short-term volatility due to unexpected incidents and accidents at oil production facilities worldwide. The market response to a problem could well be a sharp price spike, and such a response could come more swiftly than in the 1970s, because of changes in the structure of the market. Indeed, the spike in heating oil prices this past winter demonstrates how even the weather can, at least in the short term, trigger a sharp response in the market price.

3. Risk Management: Market Driven. Owing, among other reasons, to the pressure of financial and energy markets over the past few years, the various stages of the energy supply markets are more taut, with less cushion, and thus "management" of risk may end up more in the marketplace and less within companies.

4. Price and Conservation. Rising prices and the expectation of rising prices will have effects on demand, though the timing and extent is uncertain. A decade ago, as the Senate Energy Committee recognized, it was obvious that there was tremendous conservation potential, for instance, in the United States. Today, the United States uses 22 percent less energy per dollar of GNP than it did in 1979, and 29 percent less than 1973. The extent of the readily-available conservation potential in the industrial countries is less clear today, and many developing countries are at a stage where rising incomes means rising energy consumption.

5. The Production Capacity Race. Growing demand and rising prices will elicit a supply response, both from non-OPEC producers and, critically, from OPEC countries. Over the past few months eyes have turned to the subject of capacity additions in the OPEC countries. There is now much discussion about adding of new production capacity. But there are many questions. Who will add that capacity? Who will pay for it? How will it be paid for? And when? Timing is a critical question. Capacity increases in at least nine of the OPEC countries could total as much as 5 to 6 mbd by the mid-1990s. In a

very real sense, the most important driving force in the world oil markets during the 1990s may be the race between OPEC production and OPEC capacity.*

Production Capacity: The Race and the Cost

This race to increase production capacity implies a marked shift in the challenge to OPEC as well as in the psychology of the oil market. The focus has now moved away from the fact that OPEC is "overproducing," as it was in the now-fading glut period to the fact that production is nearing capacity. While many other nations will move to increase capacity, the major additions to supply will be concentrated among the Gulf producers, particularly Kuwait, Saudi Arabia, Iraq, Iran, and the UAE, plus Venezuela in our own hemisphere. This expansion will not be without cost either, as we estimate that OPEC will need to invest anywhere from $35 to $50 billion over the next five years to increase capacity by 5 to 6 mbd. But it will be surprising if capacity additions and demand increases move in perfect synchronization.

Pressures on Domestic Energy Supply

The evolution and perturbations of the world oil markets is only one part of the energy security equation for the 1990s. Indeed, since the first oil crisis the world has moved away from oil to natural gas, coal, and nuclear power. Any diversification toward those alternative fuels in the future, however, may depend more on environmental rather than energy security considerations. These limitations have particularly strong implications for the electric power industry during the 1990s. This comes at a time when the structure of the electric power industry is undergoing major changes in the U.S., and when the excess generating capacity is dwindling, particularly in the Northeast.

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*Cambridge Energy Research Associates, *OPEC's Quota Race: Demand versus Capacity.*

The Shift toward Natural Gas

To the extent that new power plant construction is required, all signals point to natural gas as the "fuel of choice" because of its technical, economic, and environmental attractiveness. Indeed, increased use of natural gas in space heating, industrial, and power generation applications seems destined to be the linchpin in our efforts to enhance energy security while improving the environmental quality. The critical question for natural gas in the 1990s will be whether the production capacity and transmission infrastructure will be in place in time to meet this incremental demand without causing major price shocks or supply curtailments. Much work has been done to prove that there still is an abundant gas resource base in North America, but it is very difficult to predict how quickly our existing production will decline, and thus how rapidly new investments in gas supply will be required.

The renewed interest in natural gas has encouraged oil and gas companies to shift their domestic exploration budgets toward natural gas, but so long as wellhead gas prices are 40 percent less than 1985 pre-crash levels, the total drilling effort will remain a small part of what occurred during the first half of the 1980s. While it may not take a complete return to those price levels to elicit a sufficient supply response, it is unlikely that the current level of prices and exploration will be enough to meet the demand. One important factor which will help balance gas markets in the 1990s will be increased imports of Canadian gas. Canadian gas imports currently supply 7 percent of U.S. gas consumption, a number that will likely rise above 10 percent by the end of the decade. Here too, however, the growth will be limited somewhat by the cost of developing incremental gas production and export infrastructure.

The Environment and Energy Security: Finding the Balance

More so than any other feature, the groundswell of concern over the environment has changed the strategic challenges of energy markets and energy security in the 1990s. Certainly concerns regarding air pollution, acid rain, and global warming provide a strong impetus to improve energy efficiency and reduce our overall level of hydrocarbon combustion. But these concerns also place constraints on domestic energy development, and particularly on those fuels such as coal and nuclear power which historically have helped enhance our energy security.

Our recent survey on public attitudes regarding energy and the environment highlights this tension. While a clear majority of those polled believed there was no conflict between environmental improvement and economic growth, attitudes were much more split on issues concerning the environment and energy security. On issues which posed less conflict between the environment and energy security, opinions were less divided. For instance, natural gas was clearly perceived to be the fuel of choice for power generation. Nearly two-thirds of the public favored incentives for domestic oil and gas exploration such as lower taxes or less regulation. The survey suggests that concerns over energy security are still strong.

As we run up against capacity constraints in the various sectors of our energy infrastructure, this conflict will come increasingly in to focus. Already we are seeing environmental concerns moving us toward a different set of fuel choices. In the late 1970s and early 1980s, we were able to enhance our energy security by shifting away from oil to coal, gas, and nuclear power. We may still be able to do this, but it may necessitate the development of commercially viable "clean-coal technologies" or a new generation of smaller, "inherently safe" nuclear reactors. This leaves natural gas as an option, so long as supplies are sufficient. On the environmental side of the equation, the imperative is to improve urban air quality and reduce the threat of acid rain and global warming. The Clean Air Bill is a very significant and important policy initiative on these issues. Even that, however, will serve to raise the cost of further developing our energy infrastructure, particularly for electric power generation capacity. Environmental needs, as related to energy, and energy supply and transmission needs, will be competing for capital investments themselves. The effort to reconcile these emerging environmental mandates, along with growing constraints on worldwide oil and energy capacity, will likely elicit a new rationale for conservation and efficiency.

The CHAIRMAN. Dr. Yergin, thank you very much.

Let us first examine this question of what is the decline in domestic production? Dr. Schmalensee said that he is not in the business of predicting domestic production, simply taking the figures as he receives them and then doing his economic magic with it.

Can you tell us, do you disagree with—I see where you project a 400,000 barrel per day decline in 1990. For the next five years to the mid-1990s, do you tend to go with EIA or with Dr. Schlesinger?

Dr. YERGIN. Well, I think we would use as a reasonable number that the decline would be somewhere, going out to the middle of the decade, might be another 1.5 to 2 million barrels a day.

Now, some of that decline will be the result of policy. For instance, there are over 1 million barrels a day by the mid-1990s which will be very sensitive to whether environmental decisions are made, whether people can or cannot drill in places, and it will also respond to sensitivity or expectations that producers have about price, and there will always be an element of surprise. I think that the half-million barrel a day drop in 1989 was a surprise. It was not thought that it would be that high. So I think with all the uncertainties that we might be looking at another 1.5 to 2 million barrel a day decline by the mid-1990s.

The CHAIRMAN. Now, 1.5 million to 2 million assumes, of course—well, it does not matter whether you drill in Alaska, because that would not be on line anyway. California, I suppose, could be on line if you started drilling now, and the polls do not show an overwhelming inclination on the part of the American people to drill in pristine areas like California, do they?

Dr. YERGIN. No.

The CHAIRMAN. If you had to make a prediction of whether we would drill based upon what the public opinion polls show, would you say drill or not in the next five years in California?

Dr. YERGIN. I would say probably not.

The CHAIRMAN. As a matter of fact, is there anything, looking at public opinion polls, that we can do in this country, if we were going to put our finger in the air based upon that, that we can do to stem this tide?

Dr. YERGIN. Well, I think that in our own survey on public opinion on energy and the environment, the one thing that we did find is that there is along with the environmental considerations there is a continuing concern about energy security, and I think that as these issues come to the fore, it will be recognized that we really do have a choice, and choices will have to be made, and that there will be support for at least some of the energy security measures.

The CHAIRMAN. Well, what I see in the polls is a desire to conserve but not a desire to pay higher taxes, which is really the best way to conserve. Back in the 1970s I felt the same way, looked at the price of gasoline in this country compared to Europe, and said well, let us see about this 50 cent a year gasoline tax phased in 10 cents a year. Actually, I was going to rebate it to the consumer under my proposal through the Social Security system, and I think I got one letter of praise from out of state, and a firestorm of criticism.

Do you think that a proposal for a big increase in the price of gasoline is likely to be praised both from the White House or by the public?

Dr. **YERGIN**. I do not think the hallelujahs will actually reach to the heavens on that.

The **CHAIRMAN**. Is there really any other way? I guess we could do CAFE standards on automobiles for conservation, but it seems to me that those are not nearly as effective or efficient, economically, as a price rise would be.

Mr. **SCHMALENSEE**. Mr. Chairman, may I speak to that? I agree entirely, and I just wanted to state my agreement.

I think that that is a point that is too often lost in the discussion, for instance in the context of climate change, where the notion is well, we can easily reduce our CO2 emissions, or at least some countries say we can easily reduce our CO2 emissions. We will merely regulate building codes and automobile mileage and toasters and refrigerators, and on and on and on.

But the plain fact is that in terms of the efficiency of reducing energy use, while there are some problems in some of these markets, taxes are—or charges, more precisely, are superior. I just wanted to underscore my agreement with that, senator.

Dr. **YERGIN**. Yes. We were very struck in our opinion poll and surprised by the degree to which the public seemed to endorse regulation, and apparently the reason they endorse regulation is they think it will be free.

The **CHAIRMAN**. And easy. And painless.

Dr. **YERGIN**. That is right.

The **CHAIRMAN**. They will have the same car, with the same protection, same speed and all that. It will just use less gasoline.

Mr. **SCHMALENSEE**. That is right, and somehow General Motors' shareholders will pay for it.

The **CHAIRMAN**. Well, if we then conclude that public opinion is going to restrain doing anything effective, then the 1.5 million to 2 million barrels which you project of declining production over the next five years is likely to come about, is it not?

Dr. **YERGIN**. Yes.

The **CHAIRMAN**. I mean, that is almost a straight line extrapolation of present trends.

Dr. **YERGIN**. I think certainly that—I think another 1.5 million barrel a day decline is a reasonable assumption to work with.

The **CHAIRMAN**. If it is 400,000 this year, five times 400,000 is 2 million barrels a day, and most of that decline, or a good portion of it, is Prudhoe Bay, is it not?

Dr. **YERGIN**. No. There are about 100,000 barrels a day out of that. But I mean, as you know the domestic exploration industry continues to be very depressed, particularly on- shore, and if there is an expectation of higher prices and some greater confidence, we could see activity increase, and that would tend to at least somewhat mitigate the decline.

The **CHAIRMAN**. Well, prices have gone up I think in gasoline, by 36 percent in the last year, is it—or is it crude oil? About 36 percent, and yet we have not seen a corresponding increase in rig count.

Dr. **YERGIN**. Yes.

The **Chairman**. I think that is because first of all there is a lack of confidence in the price. You know, bankers have been so scorched once that they are not anxious to go lend a lot of money.

Secondly, we have failed to take into consideration the changes in the Tax Code. It used to be when you were drilling with 50 cent dollars, or indeed with 30 cent dollars, it was easy to go take a big risk. But now with 72 cent dollars, it is much more difficult to take the risk.

Third, the size of the domestic industry, its capability—the number of geologists and the number of rigs and the number of people and the mud companies and roustabouts and all of those, it has been markedly and almost irrevocably diminished. Do you agree with that?

Dr. **Yergin**. Yes, and I think as you say the capital issue is a very important issue, and to all of that you have to add that there is a pessimism currently about the domestic U.S. oil potential, or relative pessimism, and you observe the opposite of what happened in the 1970s. You observe companies shifting their exploration budgets oversees and whereas perhaps a third of budgets went for overseas exploration a few years ago, now it is up to half, so that is less dollars looking for oil in the United States.

The **Chairman**. Are you concerned about that, Mr. Schmalensee?

Mr. **Schmalensee**. Concerned about it, yes, but I do not think it spells, necessarily, serious problems for the U.S. economy. Again, there will be a decline over time in the share of U.S. consumption that is covered by U.S. production. All forecasts agree on that.

Nonetheless, we observe the German and Japanese economies with none of their domestic consumption covered by domestic production, being vigorous and growing rapidly, so while a decline in production and a rising import bill is certainly a cause for concern, it does not spell, I think, the end of or a necessarily fatal problem for the U.S. economy. It is a challenge.

The **Chairman**. But the Germans and the Japanese deal with it by exporting.

Mr. **Schmalensee**. Yes, indeed.

The **Chairman**. Now, can we do that, and if so, how?

Mr. **Schmalensee**. If we are to retain our position as the leading economy in the world, a position we now hold, we will need to do more of what we are currently doing. We are currently the world's leading exporter. We will need to increase that lead, if we are to make up for an increased need to import oil.

How we will do that is by becoming more competitive in a variety of ways. The Administration has a variety of proposals that point in that direction, from education through capital gains and on and on down a list.

But the importance is, I think, to recognize that we become competitive by competing, and that if we are to retain our position into the next century we will need to move forward to increase our ability to export. I think that is quite clear.

The **Chairman**. All right. Mr. Schmalensee, when countries want to support their currencies they will go into the international market and buy dollars or marks or whatever, and while it is not—they cannot always control it very well, it seems to be a very useful tool.

Now, why should we not have a strategic petroleum reserve large enough to be able to have the threat, the implied threat of being able to get into the market and sell oil in the event someone seeks to run up the price more than they should?

Mr. SCHMALENSEE. Well the comparison is interesting and in many respects apt between currency markets and oil markets. In the case of currency markets, the evidence suggests that while intervention can have an effect, that you cannot, by buying and selling out of stocks, work for long against fundamentals.

If relations among economies are changing, exchange rates will change, and you can affect the path of change—you know, if one country is running a substantially higher rate of inflation than another, its currency will depreciate, and all the buying and selling by treasuries will not be able to prevent that in the long run.

The CHAIRMAN. But does not emotion play a large part in this, though? For example, in the Iranian oil cut-off of 1979, most experts said there was almost no deficit in world oil supply, but we had huge oil lines in this country brought on by this cascade of emotional topping off of tanks, building tanks in the back yard, et cetera. Now, if we had had a Strategic Petroleum Reserve with spare capacity so that we could have said well, we are going to release this oil to keep that price from—it more than doubled, I think.

Dr. YERGIN. Yes. I got up to $34, $38 in the spot markets.

The CHAIRMAN. Would that not have been a very useful and important purpose?

Mr. SCHMALENSEE. Mr. Chairman, I think that is a key role of Strategic Petroleum Reserve. In the work that was done, the modeling work that was done in the interagency study, that is precisely the role it plays. When excess capacity comes into play, when reserve stocks are drawn down, that moderates the price spike.

It would certainly be a price spike in the event of any disruption, and a key role of strategic stocks is to put supply on the market to bring that down, because it is the price increase itself that directly harms the economy, and the reserve is precisely aimed at moderating that.

I would—just to make one side comment, that one cannot look at the gasoline lines and so forth in the 1979 period without recalling the regulatory apparatus we had in place at that time, which certainly contributed in important ways to some of the dislocations in the market.

The CHAIRMAN. Well, there is no question about that, and as one of the chief opponents of that regime I quite agree. Nevertheless, it is true that the deficit in oil was a perceived one and not a real one, and it seems to me that we ought to go ahead and increase that strategic petroleum reserve to 2 billion—I mean, 1 billion barrels, that we ought to get that last part by leasing rather than buying the oil. Either that, or put it off-budget as we used to in the old days. That was my proposal. Because I had seen the budget come along every year, competition for the budget dollar, and we never were going to get it filled unless we went to some gimmick. That was our gimmick for those days.

It seems to me if we go to the leasing proposal today, it would be at a fraction of the cost, at least for annual outlays, and yet would give us that protection—the economic protection. Not a protection against an embargo, but a protection against some kind of economic difficulty.

Mr. SCHMALENSEE. Whether a leasing arrangement is desirable depends on, of course, the terms of the lease that can be negotiated. Certainly I agree that in principle there is potential gain from going to leasing, but it is like listening to Wall Street wizards describe complicated financing schemes. At some point where you go through this arrangement and this option and this contract you say wait a minute. Where is the gain coming from?

In the case of leasing, I think the inter-agency study there found that the potential gain was largely coming from the possibility of increased world production. That is putting aside now its budgetary implications.

But the real gain to the nation came from the possibility of increased world production beyond quotas, and certainly there is always the possibility of negotiating particularly advantageous lease terms. So, I certainly agree with the recommendation that we go forward and see if we can, in fact, negotiate such terms.

In terms of the size of the study, the size of the reserve, Mr. Chairman, that is a complicated question that involves the interaction of a variety of factors. CEA was involved in the inter-agency study, and it is my judgment that that study which, of course, made the usual set of modeling simplifications and did not have all the short-term dynamics in there, that that study did as good a job as could be done of integrating those factors.

I think that, one, there is no magic in a size. There may be mistakes there, there may be infirmities. I confess I am unaware of major, major errors in that study that would cause its conclusions to be reversed.

The CHAIRMAN. But the differences are so stark. I mean, here is Dr. Schlesinger saying that two thirds of our trade deficit by the mid-nineties will be due to oil or two thirds of our oil will be imported by the mid-nineties. The study says by 2010. I mean, that is 15 years' difference.

Mr. SCHMALENSEE. Well, yeah, there are really two things that have to be kept separate. The first is, what is the likelihood of a general secular increase in the price of oil and how rapid is it likely to be?

Everyone suggests that by the end of the century there will be an increase, and at the end of the decade. The point of disagreement is how much. But the SPR, regardless of how large, is unlikely to be able to do anything about those kind of trend increases.

Just as I said earlier, if the fundamentals internationally are going to cause the currency to depreciate or to rise over a period of several decades, there is very little central banks can do about it.

In the case of currency markets, central bank or treasury operations exist to cushion changes, to remove shocks. And that is the purpose of the SPR here.

The CHAIRMAN. But the thing is with it—with the Strategic Petroleum Reserve, if you get in and try to control this, what you think is a price spike, and you sell off oil and it does not work, then the worst has happened, that you sold oil at a great profit, and the treasury is a lot better off. You have not lost a thing.

Mr. **Schmalensee**. I agree with that. I think we are in agreement that the reserve is precisely to be used to control a spike.

The question is what is the likelihood of a spike. How soon? How rapid? Those are quantitative questions on which the report attempted to consider a wide range of views. Dr. Schlesinger's may have been outside that range. I am sorry.

Dr. **Yergin**. Well, I was going to say I think that what has changed and sometimes it takes our recognition and understanding that changes happen more slowly than the changes themselves. That is the situation that happened in the early 1970s before the first oil crisis, and that is why there are some parallels there, and a similar thing here.

We have turned around. Economic growth was higher than was expected. The falling U.S. production was greater. The unexpected problems in the Soviet Union, and suddenly we see that the world of quotas is over. The surplus era seems to be over, at least for the time being, and OPEC is operating at a very high capacity rate.

That means that there is not much give in the market, and it can be an accident in the North Sea we had two years ago. It could be problems with Soviet oil exports, and you can start making a list of things and suddenly you can see, Mr. Chairman, what you are describing, the kind of event that can cause a shock, a temporary shock, but the consequences of it can be very destabilizing to the economy.

The **Chairman**. Now, where do you come down on this question of the billion barrel reserve?

Dr. **Yergin**. Well, I have been—actually we are doing a little analytic paper on it now and have not come to conclusions, but certainly it seems that the 90-day objective that was originally established is a very sensible objective to keep to, and it is important because not only what we do but other countries look to us for leadership in this area, and their programs will be affected by what we do.

And the problem of falling production and rising imports means that you need more rather than less in that reserve.

The **Chairman**. Dr. Yergin, I recall reading in your energy futures book back a few years ago that you had a very pessimistic view of nuclear energy largely because of the public acceptance of that. Does that continue to be your view?

Dr. **Yergin**. One sees some reevaluation of nuclear power in the context of global warming issues, and it will be very interesting to see what Sweden, which was going to phase out its nuclear power, whether they actually do that or not.

But in general there does not seem to be much willingness or support for building new nuclear power plants in this country. There has not been for some years, and you see utilities—it is hard to imagine a utility wanting to commit itself in that direction.

What you see the utility industry in general doing is putting virtually all of its chips on natural gas at this period.

The **Chairman**. What do you see as the things policy-wise affecting supply that we can do and should do?

Dr. **Yergin**. For—broadly across all the energy sources?

The **Chairman**. Yes.

Dr. **Yergin**. Well, I think that we have got to look at two sides. One is the demand side and the way you were talking about, for instance, gasoline tax and so forth, and the other is what you can do to encourage a variety of supply options.

I was in Japan a few weeks ago, and I was asked a question that I did not have a good answer for. It was a question about the decline in U.S. oil production and the loss of, what was it, 700,000 barrels of stripper production over—at the beginning of the price collapse period. And the question was, what kind of—how can a country allow itself to lose 700,000 barrels a day of stripper production because if it dropped, it is going to come up again, that that production once it is gone, it is truly gone.

And I think that we need to really look at what can be done to ameliorate this dropping production in the United States. And that means things like the——

The **Chairman**. Well, I think clearly we ought to do that with stripper, but is there—do you have a high confidence in renewables and if so, how should we bring renewables on line?

Dr. **Yergin**. Well, I think—I have been just coming to the conclusion of a book I have been writing for a number of years now on energy, and I am very taken by the fact that we are continually surprised that technological innovations change occurs that we did not predict.

I think that renewables has an important role to play, and I think it is something that should be encouraged, and something that should be stimulated. Can we put a lot of chips on it today? I think no. It is like other things. It is a form of technological innovation, and costs have to come down, and progress has to be made.

It would be very beneficial if by the next century renewables could be playing a more important role.

The **Chairman**. Well, I recall during the Carter years they had a projection of 20 percent renewable—20 percent solar they used to say by the year 2000, which was sort of in my view a self-deluding projection. First, it was self-deluding because the definition of solar included wood chips and hydroelectric and things that really were not solar at all in the popular sense.

And the actual contribution of solar as we know it, panels and photovoltaics and that sort of thing was minuscule then, minuscule now, and probably will be minuscule by the year 2000. Not to say that we should not pursue it. I have been one to help pursue it, increasing to 80 megawatts, the exemption, etcetera, for solar.

But, I mean, is it not really self-delusion to say that we do not need to do any of these tough things, taxes, nuclear energy, drilling in unpopular places because renewables or solar are going to come in and save us from all that.

Dr. **Yergin**. It is certainly not reasonable to—I mean, the stakes are very high. And to make a bet on something that is not there is not a prudent thing to do.

And we have seen a kind of, again, reflecting the downturn in energy and overall change in attitudes to R&D. We have seen a retreat in this country from a lot of the basic research that needs to be done in things like photovoltaic. It is being taken up by Japan and other countries.

The CHAIRMAN. Well, do not get me wrong. I want to be very clear. I think we ought to be spending more money on those areas.

Dr. YERGIN. Yes.

The CHAIRMAN. And I think—I do not mean to denigrate the future of photovoltaics or some of the Luz technology which is parabolics and all of those things that they do. I mean, I think there is a future and I think we should pursue it.

But I think we should be very careful as a country not to delude ourselves into thinking that all we have to do is that, that that is somehow going to solve the problem because just as it—we wasted huge amounts of money in the Carter years on a lot of that. I mean, they put energy panels on the White House. I mean, it was a stunt. They had it there for a year or two, and then they quit using them, because it just did not make sense in this climate to do that.

It does not mean it does not make sense in Arizona. It does. But it was that kind of stunt that kept us from doing a lot of things we should have done. Is that not correct?

Dr. YERGIN. Yes. You know, we were going to do a lot of other things, including the synthetic fuel, the whole range of it.

I think that—as I said before, I think we are going to—during that period of falling oil prices has been generally been very beneficial to the economy and has given us a feeling that that security cushion is going to be there for a long time, and it is the disappearance of that that in our public policy and in our thinking that we are going to have to take into account so that we do not have some unpleasant surprises in the next few years.

The CHAIRMAN. Dr. Schmalensee.

Mr. SCHMALENSEE. I agree with that. All the projections indicate that the excess capacity will be diminishing and that there will be some upward pressure and that is cause for concern.

The CHAIRMAN. Are you at all concerned—Dr. Yergin, I think, tends to come down closer to Dr. Schlesinger in your domestic supply projections, is that correct?

Dr. YERGIN. Yes.

The CHAIRMAN. Are you concerned that experts like Dr. Yergin, Dr. Schlesinger and others—I do not mean to personalize this—but that they disagree so markedly with the EIA projections.

Mr. SCHMALENSEE. One always has, as we know well with our twice yearly GNP and budget deficit forecasts, a wide range of public and private forecast opinion.

I am not concerned by the existence of disagreement, per se, particularly given the size of the uncertainties in this market.

What I understood from the earlier discussion was a lot of this has to do with different assumptions about sensitivity to price changes and so forth. But I must say when we forecast—the first Bush Administration forecast about the economy last summer—a number of private forecasters were calling for serious recession by now. One gets nervous when one reads that, but it is not a cause for deep concern necessarily.

The CHAIRMAN. I mean, I guess the reason it concerns me as Chairman of this committee I feel I have a real responsibility toward energy, and if all of—if our problem is only one of well, the price is going to rise a little too much, it makes us a little uncomfortable, then that is one thing.

If, on the other hand, Dr. Schlesinger is right, then it is time to go in and tell the American public that they really need to face up to doing some things that they do not want to do. They need to get the nuclear option going. They need to start drilling in Alaska. They need to start having energy taxes. They need to do a lot of things to treat it as an impending national crisis.

Mr. SCHMALENSEE. Mr. Chairman, I have been following the general discussion in this nation and abroad of climate change, and in that context precisely the same issues arise because people are willing to say yes, carbon dioxide emissions should be reduced. They are unwilling to say we should do nuclear power, and there is in some quarters this hope that if we—if we need it badly enough, there will be inexpensive liquid fuel available from biomass, and there may be.

But there is this general reluctance to face hard choices in the energy area generally.

Dr. YERGIN. Senator, let me add that we are making an effort at Cambridge Energy to do a fresh look at the production decline numbers and to analyze it from the viewpoint of the physical resource base and when we do that, we will make that available to you and to the committee to give a range of numbers.

The CHAIRMAN. Well, I will be very interested in getting that because it is not always that pleasant to play the role of making people—trying to make people do that which they do not want to do, particularly when the public opinion polls are totally against you, and you go to your colleagues and say we have got to do this. You may not win, number one, in getting the votes and who wants to do that if it is not necessary. So, I think it is very, very important that we try to get the best numbers we can and then act on those numbers.

Now, the first thing is so clear to me. The one thing that we can do that is relatively painless and fairly effective is the Strategic Petroleum Reserve. I mean, we could take the number of dollars we are going to spend this year in buying oil. If we went to the leasing option on all of that, I suspect we could get close to our billion barrels just on what we are planning on spending on buying oil if we leased it. Maybe not quite. I really have not put the numbers to it. But I know that the cost of an annual lease payment as opposed to the cost of the outlays to buy the oil totally is a fraction of the purchase cost.

The CHAIRMAN. You are not spending that much for lease payments. And if it is unnecessary, you can always sell off that which we own. If it is necessary, then it is very vital protection for the economy.

Mr. Schmalensee, would you like to reply to that.

Mr. SCHMALENSEE. Well, I do not disagree that the protection is vital, but this, as in most other cases of insurance, comes down to the quantitative question of how much is the right amount, and I remain convinced by the analysis here that 750 million barrels is an adequate reserve.

As to the question of lease versus buying, I think from the point of view of present value, one must take into account that what leasing does unless it increases the total volume of production on the market and helps to put downward pressure on prices——

The Chairman. Well, we are really assuming that the production is in excess of OPEC quotas?

Mr. Schmalensee. Right. And that is a real value.

The second effect which hits today's budget beneficially but not necessarily tomorrow's is that you are changing the time pattern of payments. Instead of paying it all up front, you pay it over time. And on a present value basis unless you have managed to get an unusually good deal, you are not necessarily coming out ahead.

The Chairman. But when you say you pay in, you do not pay for owning the oil. You may for leasing the oil.

Mr. Schmalensee. Right, precisely.

The Chairman. You do not pay for the same thing.

Mr. Schmalensee. That is right. But to the extent that the oil that you have leased serves as protection, it is a question of getting protection by paying up front to own the oil or paying over time to lease the protection.

And unless you have got——

The Chairman. It is the difference between a whole life insurance policy and a——

Mr. Schmalensee. That did occur to me, Mr. Chairman, yes. [Laughter.] And unless—no one can ever understand those anyway.

And unless the company is mispricing its policies, you do not get rich by choosing one or the other.

The Chairman. Well, gentlemen, thank you very much. This has been very instructive and very interesting. We have not been disappointed in your testimony at all and, Dr. Yergin, I very much look forward to getting your analysis on the strategic petroleum reserve.

Dr. Yergin. We will do that.

[The information follows.]

The Chairman. Thank you very much, gentlemen.

Mr. Schmalensee. Thank you, Mr. Chairman.

[Whereupon, at 12.22 p.m., the hearing was adjourned.]

APPENDIXES

APPENDIX I

Responses to Additional Questions

J. BENNETT JOHNSTON, LOUISIANA, CHAIRMAN

DALE BUMPERS, ARKANSAS
WENDELL H. FORD, KENTUCKY
HOWARD M. METZENBAUM, OHIO
BILL BRADLEY, NEW JERSEY
JEFF BINGAMAN, NEW MEXICO
TIMOTHY E. WIRTH, COLORADO
KENT CONRAD, NORTH DAKOTA
HOWELL T. HEFLIN, ALABAMA
JOHN D. ROCKEFELLER IV, WEST VIRGINIA

JAMES A. McCLURE, IDAHO
MARK O. HATFIELD, OREGON
PETE V. DOMENICI, NEW MEXICO
MALCOLM WALLOP, WYOMING
FRANK H. MURKOWSKI, ALASKA
DON NICKLES, OKLAHOMA
CONRAD BURNS, MONTANA
JAKE GARN, UTAH
MITCH McCONNELL, KENTUCKY

DARYL OWEN, STAFF DIRECTOR
D. MICHAEL HARVEY, CHIEF COUNSEL
FRANK M. CUSHING, STAFF DIRECTOR FOR THE MINORITY
GARY G. ELLSWORTH, CHIEF COUNSEL FOR THE MINORITY

United States Senate
COMMITTEE ON
ENERGY AND NATURAL RESOURCES
WASHINGTON, DC 20510-6150

April 2, 1990

The Honorable John J. Easton, Jr.
Assistant Secretary, International Affairs
and Energy Emergencies
U. S. Department of Energy
1000 Independence Avenue, S.W.
Washington, D. C. 20585

Dear Mr. Easton:

I would like to thank you for your recent appearance at the hearing held by the Committee on Energy and Natural Resources on March 26, 1990. Your time and effort to provide the Committee with your views regarding the World Oil Outlook is greatly appreciated.

In order to assist the Committee in its consideration of this issue, I am attaching an additional question for inclusion in the hearing record. I would appreciate your sending your responses to Karl Hausker of the Committee staff by April 18, 1990.

Again, thank you for your testimony. I look forward to receiving your additional comments.

Sincerely,

J. Bennett Johnston
Chairman

JBJ/kah

Question for the Department of Energy
from Sen. J. Bennett Johnston
Oversight Hearing on World Oil Outlook
March 26, 1990

1. On page 4 of his prepared testimony, Dr. Schmalensee of the Council of Economic Advisers stated that:

   "[T]he economy incurs temporary frictional losses of output and employment whenever prices change in any important sector, such as the oil market.... Because frictional losses are temporary, a permanent doubling of the oil price would raise the cost only to between 1.5 percent and 3.0 percent of a single year's GNP."

   The cost-benefit analysis of oil import fees in DOE's 1987 Energy Security report apparently used a different perspective. Frictional losses due to oil price increases (caused by oil import fees) apparently were estimated to cause permanent frictional losses (see discussion on p. D-16 ff. and Tables B-1 through C-5). At a minimum, the frictional losses were fairly constant throughout the eight-year period of analysis.

   a. Is it accurate to say that there is a substantial disagreement between Dr. Schmalensee and the authors of the Energy Security report? What is your view of the nature of that disagreement?

   b. What is the Administration's current view on the duration of frictional losses caused by oil price increases?

   c. In qualitative terms, what would be the effect on the cost and benefit estimates in the 1987 analysis of oil import fees of:

      1) adopting Dr. Schmalensee's view of frictional losses,

      2) accounting for the higher levels of oil imports now projected, and

      3) accounting for other significant changes in the world oil market in the last three years.

Department of Energy
Washington, DC 20585

May 9, 1990

The Honorable J. Bennett Johnston
Chairman
Committee on Energy and Natural Resources
United States Senate
Washington, D.C. 20510

Dear Mr. Chairman:

On March 26, 1990, John J. Easton, Jr., Assistant Secretary, International Affairs and Energy Emergencies gave testimony before your committee on the world oil outlook.

Following that hearing, you submitted written questions to supplement the record. Enclosed are the answers to those questions.

If you have any questions, please have your staff call Barbara Barnes on 586-8687. She will be happy to assist.

Sincerely,

Jacqueline Knox Brown

Jacqueline Knox Brown
Assistant Secretary
Congressional & Intergovernmental Affairs

Enclosure

Questions Submitted by the Honorable J. Bennett Johnston

Question 1a: Is it accurate to say that there is a substantial disagreement between Dr. Schmalensee and the authors of the Energy Security report? What is your view of the nature of that disagreement?

Answer 1a: There are no disagreements between Dr. Schmalensee and the authors of the 1987 Energy Security report. There are differences between the results of the Strategic Petroleum Reserve Analysis of Size Options and the Energy Security Report due to radically different scenarios they analyze, but the methodology of the cost-benefit calculations in each is essentially the same. Since its appearance, there has been much discussion about the methodology used in the 1987 Energy Security report to estimate the GNP loss as a result of an oil import fee. The period 1988 to 1995 was chosen as the duration for the oil import fee study. The choice of 1995 as a stopping point was completely arbitrary. That is, the choice of this eight year period has no analytical significance in and of itself. It should not be interpreted as the "short-run," or the duration of frictional effects.

There are two types of GNP effects which could result from an oil price change. There is a temporary, "frictional" loss as labor and other factors of production adjust to the change in the price of oil relative to other commodities. There could also be a permanent reduction of GNP below its potential. The total GNP effect and its composition are heavily dependent on the type of price change scenario considered. The Energy Security report considered a permanent increase in price due to the fee whereas the Strategic Petroleum Reserve (SPR) Size study considered only short term price changes.

Question 1b: What is the Administration's current view on the duration of frictional losses caused by oil price increases?

Answer 1b: The duration of the frictional effects caused by a temporary oil price shock is based on the economic agencies' review of the evidence from some respected and widely used macroeconomic models. Because frictional losses, by definition, are due to temporary losses of employment and output, a good measure of the duration of these losses is how long it takes for employment to return to its pre-shock level. We believe that most of the GNP effects observed in macroeconomic models during the first two years are primarily cyclical effects.

Question 1c: In qualitative terms, what would be the effect on the cost and benefit estimates in the 1987 analysis of oil import fee of:

1) adopting Dr. Schmalensee's view of frictional losses,

2) accounting for the higher levels of oil imports now projected, and

3) accounting for other significant changes in the world oil market in the last three years.

Answer 1c: Dr. Schmalensee's view of frictional losses is based on the economic agencies' analysis for the *SPR Size Option* study. The calculation of GNP losses in the 1987 *Energy Security* report follows a computational framework similar to that used in the *SPR Size Option* study. As explained above, there is no contradiction between Dr. Schmalensee's explanation of frictional losses and the *Energy Security* report, once one understands the methodology of the two reports. Therefore his view would not change the *Energy Security* report.

The higher levels of oil imports now projected will not significantly alter the cost and benefit estimates. In the 1987 import fee analysis, the impact of an import fee on GNP was calculated based on the following relationship:

$GNP_F = GNP_B * (P_F/P_B)^e$

where GNP=Gross National Product
P=Domestic refiners acquisition costs
B=Before a fee is imposed
F=After an oil import fee is imposed
e=GNP elasticity

Higher imports would raise the GNP losses only if an import fee in today's environment would cause the P_F to be higher relative to P_B than in the 1987 study.

Refiners acquisition costs would be higher as a result of an oil import fee because the fee would increase the price of both domestic and imported sources of crude oil. The higher cost would not be "due to higher import levels." The mix is not a factor, because all oil in the U.S. would be higher priced. The change in oil demand as a result of an oil import fee in the United States should be about the same even though the import levels of crude oil would have increased.

Recent changes in the world oil market can change the costs of an import fee significantly. An import fee would raise the costs of inputs to oil consuming industries in the United States relative to foreign countries. In the energy intensive industries, this cost differential may be detrimental to the competitiveness of U.S. industries in the international market. As a result, the GNP loss may be greater as the importance of international trade grows over time. This negative impact on the competitive position of the U.S. would increase the costs of an oil import fee.

J. BENNETT JOHNSTON, LOUISIANA, CHAIRMAN

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United States Senate

COMMITTEE ON
ENERGY AND NATURAL RESOURCES
WASHINGTON, DC 20510-6150

April 2, 1990

The Honorable John J. Easton, Jr.
Assistant Secretary, International Affairs
and Energy Emergencies
U. S. Department of Energy
1000 Independence Avenue, S.W.
Washington, D. C. 20585

Dear Mr. Easton:

I would like to thank you for your recent appearance at the hearing held by the Committee on Energy and Natural Resources on March 26, 1990. Your time and effort to provide the Committee with your views regarding the World Oil Outlook is greatly appreciated.

In order to assist the Committee in its consideration of this issue, I am attaching an additional question for inclusion in the hearing record. I would appreciate your sending your responses to Karl Hausker of the Committee staff by April 18, 1990.

Again, thank you for your testimony. I look forward to receiving your additional comments.

Sincerely,

J. Bennett Johnston
Chairman

JBJ/kah

Question for the Department of Energy
from Sen. J. Bennett Johnston
Oversight Hearing on World Oil Outlook
March 26, 1990

1. On page 4 of his prepared testimony, Dr. Schmalensee of the Council of Economic Advisers stated that:

   "[T]he economy incurs temporary frictional losses of output and employment whenever prices change in any important sector, such as the oil market.... Because frictional losses are temporary, a permanent doubling of the oil price would raise the cost only to between 1.5 percent and 3.0 percent of a single year's GNP."

   The cost-benefit analysis of oil import fees in DOE's 1987 Energy Security report apparently used a different perspective. Frictional losses due to oil price increases (caused by oil import fees) apparently were estimated to cause permanent frictional losses (see discussion on p. D-16 ff. and Tables B-1 through C-5). At a minimum, the frictional losses were fairly constant throughout the eight-year period of analysis.

   a. Is it accurate to say that there is a substantial disagreement between Dr. Schmalensee and the authors of the Energy Security report? What is your view of the nature of that disagreement?

   b. What is the Administration's current view on the duration of frictional losses caused by oil price increases?

   c. In qualitative terms, what would be the effect on the cost and benefit estimates in the 1987 analysis of oil import fees of:

      1) adopting Dr. Schmalensee's view of frictional losses,

      2) accounting for the higher levels of oil imports now projected, and

      3) accounting for other significant changes in the world oil market in the last three years.

APPENDIX II

Additional Material Submitted for the Record

Cambridge Energy Research Associates

THE STRATEGIC PETROLEUM RESERVE:
AN OPERATIONAL PERSPECTIVE

COUNCIL ON FOREIGN RELATIONS
New York, NY

by Dr. Dennis Eklof

April 16, 1990

This paper was prepared for a Council on Foreign Relations study group on the Strategic Petroleum Reserve made possible by a grant from The Arthur Ross Foundation.

Dennis Eklof is a Senior Consultant at CERA. Dr. Eklof is a leading expert on refining, oil products and markets, and strategic planning. He is author or coauthor of several CERA reports, including *U.S. Gasoline Demand: Solving the Puzzle*, *Downstream Profitability in the 1990s*, and *The Future of the Asia/Pacific Oil Market*.

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THE STRATEGIC PETROLEUM RESERVE: AN OPERATIONAL PERSPECTIVE

By Dennis Eklof

This report analyzes considerations that have shaped the current design of the Strategic Petroleum Reserve (SPR) and its current capabilities.

Conclusions

- Many of the issues about the SPR's ability to perform as planned are a reflection of basic design decisions made at the outset of the program and motivated by the single-minded goal of building up strategic stocks as quickly as possible.
- Within the limitations of the basic design, great progress has been made toward ensuring that the SPR will meet its original objectives.
- Wherever technically and economically feasible, the system has been tested and meets its design goals.
- Major areas that are critical to the successful use of the SPR, the most important of which is logistics, cannot be effectively evaluated except in the case of a real supply emergency.
- There are technical and procedural limitations that virtually preclude the effective use of SPR as a buffer against short-term shortages and price spikes as occurred on the West Coast in the aftermath of the Alaskan oil spill and in New England during the December 1989 cold snap. But in any event, the SPR is meant as a "strategic reserve," not a price-buffering reserve.
- Ongoing annual operating costs to maintain the SPR at 750 million barrels are likely to be $0.16 to $0.20 per barrel in 1989 dollars. At today's oil prices, annual interest costs associated with the value of the oil in the reserve are $1.30 to $1.40 per barrel. Thus the annual cost of the SPR, once development and fill is complete, will be about $1.1 billion per year.

The Strategic Petroleum Reserve: Goals and Legislative Background

The Energy Policy and Conservation Act, signed into law late in 1975, authorized the creation of the Strategic Petroleum Reserve (SPR) with the dual goals of protecting the U.S. economy from future supply disruptions and fulfilling the U.S. obligation under the International Energy Program. The act specified that up to 1 billion barrels of crude oil and refined products were to be stashed away as an insurance policy. What the act did not specify was how this was to be done and within what time frame. Those decisions had to await the development of a detailed SPR plan that was completed and became effective in early 1977.

One of the main goals behind the plan was to place a large quantity of oil into storage as quickly as possible -- a design goal that continues to affect SPR operations. The initial target was to have 150 million barrels in storage by December 1978 and 500 million barrels by December 1982. Neither of these goals was achieved. In June 1977, the 500-million-barrel target was advanced by two years to December 1980. In fact, the amount in storage did not exceed 500 million barrels until sometime in 1986. In May 1978, the act was again amended to increase the size of the SPR to 1 billion barrels, but the amendment included schedules and detailed plans only for the increment from 500 million to 750 million barrels.

The Basic Design Decisions: A Compromise Between Sound Engineering, Deadlines, and Costs

Four basic decisions were embodied in the original SPR plan:

- The SPR should consist of crude oil only. The 1977 plan called for the entire SPR to consist of crude oil. There are several compelling reasons for this decision. First, some products, particularly gasoline, deteriorate over time or have specifications that vary from season to season. These refined products must be periodically turned over -- a process that would not be possible within the limits of the SPR's other design parameters. Second, it was reasoned that the storage of crude provided maximum flexibility with no significant loss in security, as any interruption of product imports could be made up for by higher refinery runs in the U.S. or by processing SPR crude in offshore refineries. Third, the logistics associated with handling a variety of products rather than only two crudes (low sulfur and high sulfur) would have been much more complex. Finally, the sources of products and types of products imported into the U.S. were viewed as constituting a relatively lower risk than crude imports.

- The SPR should be established in salt domes along the U.S. Gulf Coast. This decision was based both on cost considerations and on the goal of rapid SPR fill. Establishing regional reserves would have drastically increased the cost of the program as reserves in the mid-Continent, East Coast, and West Coast would have required the construction of above-ground steel or below-ground concrete storage tanks at much higher costs compared to the use of existing or new salt caverns. The recently completed SPR expansion study shows the following 1989 costs for site development of a 100 million barrel capability:

Expansion of existing salt dome site	$3.50 - $4.50 per barrel
New salt dome site	$5.00 - $7.50 per barrel
East coast in-ground tanks	$8.80 - $10.50 per barrel
East coast above-ground tanks	$14.80 - $16.50 per barrel

  The concentration of refineries, marine terminals, and crude pipeline junctions in the area added to the attractiveness of Gulf Coast locations.

- Oil withdrawal would be done by means of fresh water injection. The technology associated with the storage of petroleum liquids in underground salt caverns was established long before the development of the SPR. The Louisiana Offshore Oil Port (LOOP), for example, uses underground salt domes as working storage. Withdrawal of oil from these caverns relies on the fact that oil floats on water. To withdraw the oil from SPR caverns, water is pumped into the bottom of the cavern, and the growing volume of water drives oil out the top (see Figure 1). Refilling the cavern involves pumping the oil in the top and withdrawing the water from the bottom. Unfortunately, each time this cycle is repeated a certain amount of additional salt is dissolved, and eventually the walls of the cavern become too thin and the cavern can no longer be used. In situations such as the LOOP where frequent filling and emptying are planned, brine is used instead of water, thereby avoiding unwanted dissolution of the cavern. But this requires the extra cost of brine handling and storage facilities. For each barrel of oil storage, a barrel of brine storage must be provided to contain the brine when the cavern is full of oil.

  In the case of the SPR, repeated filling and withdrawal was not anticipated so the withdrawal operation was designed to rely on fresh water taken from nearby sources, thus saving the cost of building brine storage facilities. Most of the current salt caverns in the SPR were designed for a useful life of five fill cycles.

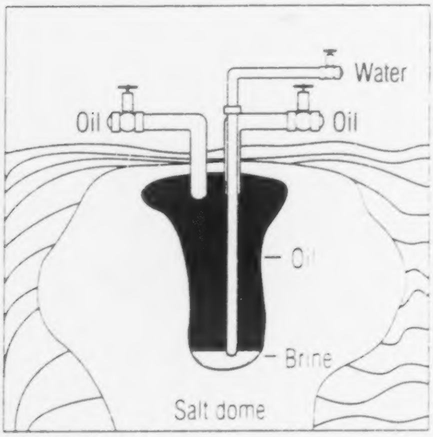
- Maximum use would be made of available existing sites. This decision was dictated by the fill targets set by Congress. New salt caverns of the size envisioned in the SPR plan -- about 10 million barrels -- can take as much as two years to develop, so existing sites had to be used wherever possible. While this decision contributed to meeting the fill goals, it required other compromises that are discussed below.

Storage Facilities: Nearing Completion

The SPR now consists of six separate sites grouped into three distribution systems based on site location (see Figure 2). Five of the sites are underground salt caverns, while the sixth, at Weeks Island, Louisiana, is based on totally different technology. The Weeks Island site is a

Figure 1

Secure, Economical Crude Oil Storage

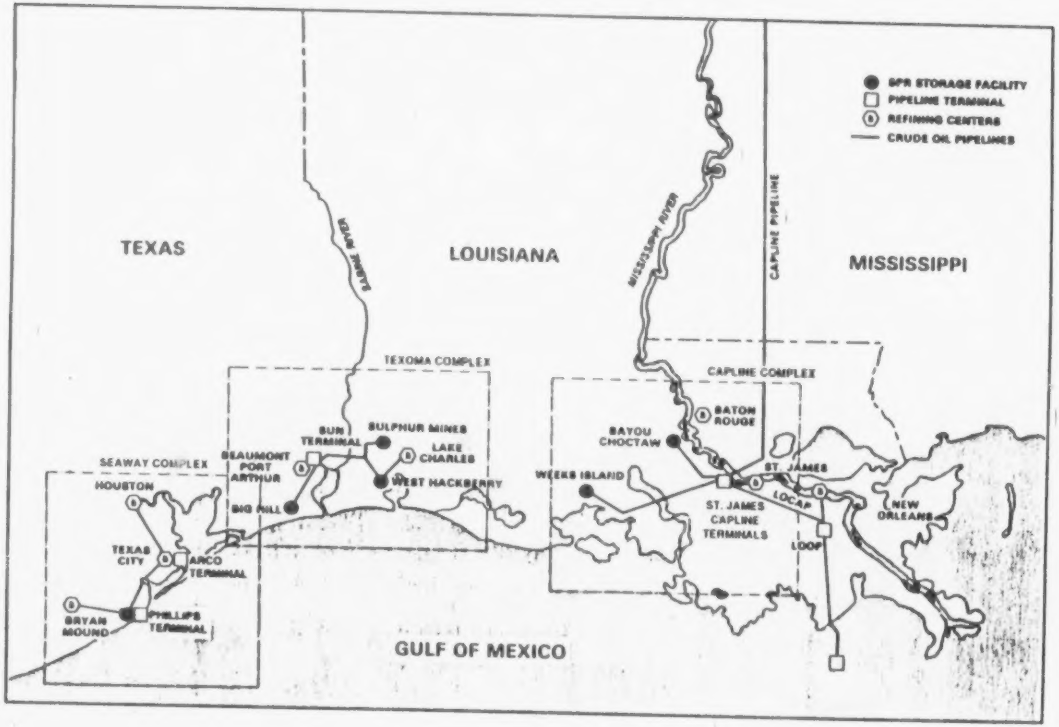

Water
Oil
Oil
Oil
Brine
Salt dome

STANDBY STAGE

Source: U.S. Department of Energy.

Figure 2

Strategic Petroleum Reserve Complexes and Associated Pipelines and Terminals


● SPR STORAGE FACILITY
□ PIPELINE TERMINAL
Ⓡ REFINING CENTERS
— CRUDE OIL PIPELINES
TEXAS
LOUISIANA
MISSISSIPPI
SABINE RIVER
MISSISSIPPI RIVER
CAPLINE PIPELINE
TEXOMA COMPLEX
CAPLINE COMPLEX
SEAWAY COMPLEX
HOUSTON
TEXAS CITY
ARCO TERMINAL
BRYAN MOUND
PHILLIPS TERMINAL
BEAUMONT PORT ARTHUR
BIG HILL
SUN TERMINAL
SULPHUR MINES
LAKE CHARLES
WEST HACKBERRY
WEEKS ISLAND
BAYOU CHOCTAW
BATON ROUGE
ST. JAMES
LOCAP
ST. JAMES CAPLINE TERMINALS
LOOP
NEW ORLEANS
GULF OF MEXICO

Source: U S Department of Energy.

converted, mechanically mined salt mine that was purchased from the Morton salt company. Oil is stored at the bottom of the mine (as opposed to the top of a cavern) and is withdrawn by huge submersible pumps - a much more troublesome technology.

Surface facilities sufficient to hold the target capacity of 750 million barrels have been completed at all sites and all cavern development is complete except at Big Hill in Texas and Bayou Choctaw in Louisiana. Leaching at those two sites is scheduled for completion by 1991. One Louisiana site, Sulfur Mines, will be decommissioned in 1991. The U.S. Department of Energy (DOE) has decided that the facility is too small to be economical, so the oil will either be sold or moved to other sites. Total SPR storage capacity by mid-1990 will be about 750 million barrels.

These facilities have come a long way from the early days of the SPR when the order of the day was to find an available hole in the ground and fill it with oil. The passage of time has allowed for proper and impressive engineering of the facilities and for the upgrading of hardware and control systems to match the SPR's strategic goal. The sites visited by CERA displayed state-of-the-art control systems, well maintained equipment, extensive backup systems, and professional staffing.

Getting the Oil to Market

To be useful as a strategic tool, the stockpiled crude has to get to the refiner. The transportation of SPR crude is based on maximum use of commercial distribution facilities. Thus, with the exception of the DOE terminal at St. James, Louisiana, DOE ownership of distribution facilities is limited to the pipelines necessary to link the SPR sites to some critical node in the national crude oil distribution system. Distribution from that point is left to the industry. Each of the three distribution systems -- Seaway, Texoma, and Capline -- has both pipeline and tanker capabilities, as is shown in Table 1.

Table 1

SPR Drawdown and Distribution Capability
(mbd)

	Pipeline	Marine	Withdrawal
Current			
Capline	1.07	0.435	1.07
Texoma	0.415	1.09	1.50
Seaway	1.00	0.65	1.10
Total	**2.485**	**2.175**	**3.57**
Planned			
Capline	1.07	0.635	1.07
Texoma	0.45	1.77	2.18
Seaway	1.00	0.75	1.25
Total	**2.52**	**3.155**	**4.50**

Marine facilities for the Texoma and Seaway systems are provided by agreement with commercial terminal operators while the Capline system relies on DOE's St. James facility for marine access (see Figure 3).

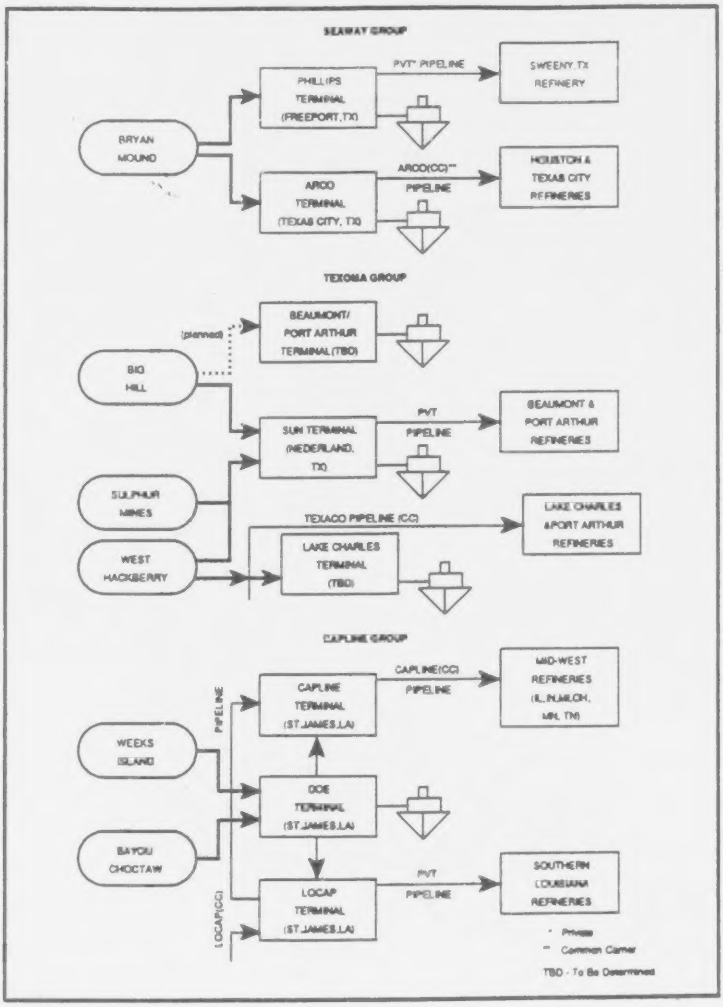
The Burdens of Past Compromises

Despite improvements that have been made in the SPR facilities in the last decade, some of the initial system design compromises and priorities still add to the cost of the SPR and raise questions about its ability to live up to its potential. Most of these questions revolve around the decision to use facilities already in existence, particularly at the Weeks Island site.

At all of the other SPR sites, the salt caverns were formed by dissolving a cylindrical cavity in the salt by continually pumping fresh water in the cavern and removing brine until the desired size was reached. The resulting cavern is typically about 200 feet in diameter and 2,000 feet high. Access to the cavern is through two relatively small wells, not unlike shallow oil wells. The cavern is always filled with liquid, and is pressurized to about 700 pounds per square inch.

Figure 3

Current and Planned Strategic Petroleum Reserve Distribution System for the Seaway, Texoma, and Capline Groups


SEAWAY GROUP
PVT* PIPELINE
SWEENY TX REFINERY
PHILLIPS TERMINAL (FREEPORT, TX)
BRYAN MOUND
ARCO(CC)** PIPELINE
HOUSTON & TEXAS CITY REFINERIES
ARCO TERMINAL (TEXAS CITY, TX)
TEXOMA GROUP
BEAUMONT/ PORT ARTHUR TERMINAL (TBD)
(planned)
BIG HILL
PVT PIPELINE
BEAUMONT & PORT ARTHUR REFINERIES
SUN TERMINAL (NEDERLAND, TX)
SULPHUR MINES
TEXACO PIPELINE (CC)
LAKE CHARLES &PORT ARTHUR REFINERIES
WEST HACKBERRY
LAKE CHARLES TERMINAL (TBD)
CAPLINE GROUP
CAPLINE(CC) PIPELINE
MID-WEST REFINERIES (IL, IN, MI, OH, MN, TN)
CAPLINE TERMINAL (ST. JAMES, LA)
PIPELINE
WEEKS ISLAND
DOE TERMINAL (ST. JAMES, LA)
BAYOU CHOCTAW
PVT PIPELINE
SOUTHERN LOUISIANA REFINERIES
LOCAP TERMINAL (ST. JAMES, LA)
LOCAP(CC)
* Private
** Common Carrier
TBD - To Be Determined

Source: U.S. Department of Energy.

The Weeks Island facility, as described earlier, is not a leached cavern in a salt dome, but a converted salt mine. The storage cavern was formed by conventional room-and-pillar mining techniques. As a result it provides a host of special problems.

- Since the cavern was dug by men and machines, it is open to the surface. Thus bulkheads had to be built to isolate the oil storage portions of the cavern. While development of the site was completed in 1982, additional isolation bulkheads are still being designed.
- Since the cavern is not filled with liquid at all times, the combination of air and crude together in the cavern would present a danger of explosion. To avoid this danger, an inert gas atmosphere must be maintained in the cavern.
- With leached caverns, all of the mechanical and electrical equipment is located above ground where it can be more easily monitored and maintained. At Weeks Island, the pumps, which are critical to the drawdown process, are located deep in the mine where the ever-present salt creates serious corrosion problems. Despite redundancy in the exiting pumps, a complete alternative drawdown system will be installed by 1991.
- Full recovery of the oil will not be possible. In leached cavern storage, the fresh water that is pumped in to force the oil to the surface dissolves a portion of the salt, freeing for recovery oil that was stuck to the walls of the cavern. At the Weeks Island site, some of the oil will remain trapped in pockets and stuck to the walls of the mine. This could result in a recovery rate for this site of only 96 percent.

In addition to the problems that are unique to the Weeks Island site, the use of preexisting facilities also presents problems, albeit less formidable, at other locations.

- Use of existing equipment means less standardization of hardware and thus higher maintenance costs and potentially reduced reliability.
- Sharing physical sites with commercial operators -- the case at both Weeks Island and Bayou Choctaw -- adds to security costs and problems.
- More efficient physical locations might have been available, easing the logistics problems associated with withdrawal.

A Well-Tested System -- To a Point

How can an emergency system be tested when there is no emergency? This is the main foundation for most of the concerns about the ability of the SPR to perform as planned. The technology associated with storage and retrieval of oil from underground salt domes is well established. From a facilities and technology perspective, the SPR is distinguished from the commercial use of salt dome storage by four factors:

- the size of the reserve;
- the length of inventory retention;
- its stand-by status;
- the high drawdown rate.

System Size

The total volume of the SPR dwarfs commercial operations. The National Petroleum Council estimates that, excluding the SPR, typical crude oil inventories in the U.S. exceed operating minimum levels by only 55 million barrels while the SPR will ultimately total 750 million barrels. Yet the SPR consists of 61 different caverns, none of which offers any particular technical challenge.

Retention Time

Excluding the SPR, salt domes are normally used as working storage and the retention time is short. SPR oil will remain in the cavern indefinitely. This long retention period poses some additional operating problems for the SPR, but most of these translate into minor increases in operating costs and are not of concern. Yet unanticipated problems can develop. One example of such an unexpected development concerns methane gas. The salt in which the crude oil is stored contains varying quantities of methane gas. Recently, there have been some indications that in two of the caverns some of that methane is migrating into the crude. If this proves to be the case, a situation could develop where gas separating equipment would be required at the storage site to reduce methane levels sufficiently to allow safe transportation of the crude through the pipeline system. Given the high rate of planned drawdown, this could be a major technical challenge and a large cost. Testing is under way to determine the significance and accuracy of the early indications, and it is far from certain that the migration is even occurring. But it is a good example of the possibility of unexpected problems.

Drawdown Rate

The ability to achieve planned drawdown rates from individual sites for limited periods of time can be accurately evaluated. Recent tests have generally reached or exceeded designed rates of drawdown. In 1989, for example, there were successful tests of both the Bayou Choctaw and West Hackberry sites. But these tests demonstrate only a subset of the technical capabilities that will be required to meet the SPR's stated goals.

Questions about other capabilities will remain unanswered for technical and economic reasons. Limited storage tank capacity at the marine terminals and pipeline junctions linked to the system means that the drawdown tests are limited to a few hours in duration. The use of fresh water to move oil out of the caverns means that the tests must be not only relatively short in duration, but also relatively infrequent. Thus the ability of the systems to sustain planned rates of drawdown beyond a few hours cannot be tested.

This reliability concern has been recognized, and in order to help respond to it, redundancy has been built into the systems in areas that are critical for drawdown, and state-of-the-art monitoring and control systems have been installed. There is reason to believe that these capabilities will permit rapid adjustment to compensate for any system failures, but overall system reliability will remain untested until a real crisis emerges. And there is some question as to how much margin there is to accomodate unexpected problems.

Stand-by Status

Maintaining the reliability of the SPR hardware is made more difficult by the stand-by status of the facilities once development is complete. In a commercial system that is constantly in use, technical information on system performance and reliability can be continuously gathered and evaluated. The system can be continually fine-tuned to operate effectively. And this experience-curve phenomenon is pervasive. Spare parts inventories are adapted to actual system performance to ensure on-hand availability of needed spares. Maintenance crews become more proficient at diagnosing and repairing problems. System operators become more experienced. Control systems and related software are debugged and improved. The staff of the SPR is making a concerted effort at climbing this experience curve through test exercises, training programs, and simulated operation. Yet there is no replacement for actual operating experience.

There is more involved in the successful performance of the SPR than the technical and operational capabilities of the storage and withdrawal systems; the crude has to get into the commercial distribution system and to the refiner. This involves a myriad of commercial and logistics operations, and it is in this area where the stand-by status of the SPR may present an even bigger challenge.

To meet the goals of the SPR in the event of a crisis, the idle facilities will have little time to change from a stand-by operation to a critical part of the U.S. supply system, moving oil in volumes equivalent to Saudi Arabia's oil exports in 1986. As an example of how formidable a task this can be, in 1989, the SPR fill rate averaged 62,000 barrels per day -- equivalent to a single 80,000 dead weight ton tanker unloaded every 10 days divided among several terminals. Only three tankers have been loaded in the entire history of the SPR. If maximum use is made of pipeline delivery capabilities, distributing 3.57 million barrels per day (the current drawdown limit) would require loading 1.8 80,000 ton tankers *each day*. In practice, many smaller ships would be used and the scheduling and operation of dock facilities would be correspondingly more complex.

And, the ships might not be immediately available. Full-scale use of the SPR almost certainly would necessitate a waiver of the Jones Act which requires that only U.S. flag ships move goods between two U.S. ports. The existing U.S. flag crude transportation fleet could not handle the required volume of SPR crude. Currently, there is a formal agreement among the DOE, the Customs Service, and the U.S. Maritime Administration to expedite the review of a requested waiver of the Jones Act in the event of an oil supply emergency, but such a waiver would not be not automatic.

The proper functioning of the critical logistical aspects of the SPR can never be fully evaluated in advance of a crisis. The DOE is continually developing training programs, computer models that simulate operations under emergency conditions, and test exercises. Yet the very nature of the system limits pre-crisis testing and the opportunity for hands-on experience.

Short-Term Market Disturbances and the SPR

Using the SPR to counteract short-term price distortions such as those caused by the Alaskan oil spill and the December 1989 cold spell is not practical for two reasons.[*] First, the absolute minimum time needed to get SPR oil to refiners would be 16 days. In practice, it would take longer, and additional time would be involved in refining the crude and getting the product to consumers. Second, repeated use of the salt caverns using fresh water for drawdown would eventually destroy the caverns.

Ongoing Costs: Hard to Estimate

Ongoing costs to support the SPR are difficult to predict. It has been estimated that an annual budget of $120 million will be needed once the facilities are fully developed and the full 750 million barrels has been purchased. This would cover the necessary costs of maintaining the facilities in a stand-by status, providing security forces, administration, etc. Yet there are additional costs.

In fact, the December 1989 shortage was due to problems in the refining and product ransportation sectors of the industry, *not* crude supply.

The facility may never be free from the need for capital investment. As the U.S. oil market changes, the SPR must continually adapt if it is not to become obsolete. Changes in Seaway and Texoma systems have proved examples of this need. These systems were designed to get crude to refiners through connections to the crude oil pipelines bearing the same names. Today, however, the Seaway and Texoma crude oil pipelines do not exist. Declining oil demands in the 1980s prompted the conversion of these pipelines to natural gas, and the SPR was forced to develop alternative means of distribution. New pipelines were built by the DOE to connect these two systems to alternative outlets.

Another cost is that associated with holding the inventories. Assuming a current market value of the crude of $17 per barrel, the oil currently in the SPR has a market value of $9.75 billion and an annual interest cost at 7 percent of $680 million. Thus the stand-by operating cost of the SPR will be at least $800 million annually, or about $1.40 per barrel.

Cambridge Energy Research Associates Inc

THE STRATEGIC PETROLEUM RESERVE
AND U.S. ENERGY SECURITY

Working Paper

COUNCIL ON FOREIGN RELATIONS

New York City

by Dr. Joseph Stanislaw and Dr. Daniel Yergin

April 16, 1990

This paper was prepared for a Council on Foreign Relations study group on the Strategic Petroleum Reserve made possible by a grant from The Arthur Ross Foundation.

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THE STRATEGIC PETROLEUM RESERVE AND U.S. ENERGY SECURITY

By Joseph Stanislaw and Daniel Yergin

INTRODUCTION

The shift in prospects for the world oil market and renewed concerns about energy security are focusing attention on a big pot of oil that compares favorably in size to a large North Sea oil field. But this particular accumulation is not an oil field created by nature, but rather a man-managed reservoir into which oil is put that has been pumped elsewhere in the world and then transported to South Texas or Louisiana, in order to be put back into the ground. The accumulation in question is the U.S. Strategic Petroleum Reserve (SPR); and what is being scrutinized in the changing political and economic circumstances is the size and operation of the SPR, its utility in a crisis, and indeed its very purpose.

The SPR was established in 1975, in the aftermath of the 1973-1974 oil crisis, in order to provide a buffer against future supply disruptions, whether politically induced or as the result of economic or technical factors. The essential concept is that large amounts of SPR oil pouring into the market would counteract the innate tendency in a crisis to bid feverishly for supplies and to hoard by building inventories. The use of the SPR would eliminate the specter of shortage which is what activates the hoarding instinct. But, at the time of the "Second Oil Shock," which began at the end of 1978 with the collapse of the Shah's regime in Iran, the SPR was still quite small -- only 68 million barrels -- and the ability to "draw down" (withdraw and distribute) the oil was limited. As a result, the SPR played little role, save to be a source of controversy as to whether it should continue to be filled or not during a supply crisis.

At the beginning of 1990, by contrast, the SPR holds 580 million barrels, which is the equivalent of 77 days of net imports, and it is often now described as the "first line of defense" in America's energy security. Those 580 million barrels had been acquired at a cost of $16 billion.

Over the past few years, net U.S. oil imports have been rising quickly, and that, in part, provides the backdrop for the current debate. The current authorization for the SPR runs out shortly, and thus political decisions will be required in the near term on its future. The major controversies regarding the SPR include:

- Size: Current plans call for bringing the SPR up to 750 million barrels by the end of this decade. Since U.S. imports are rising, some argue that the target be raised to one billion barrels.

- Financing: Is the SPR cost effective? Can the SPR be filled through less expensive means than buying barrels outright, such as by "leasing" oil from Saudi Arabia and other exporters?

- Operations: In a crisis, will the SPR operate successfully -- in a physical and logistical sense?

- Activation: Current policy calls for "early release" in a crisis. How would the SPR actually be used? Would it get into the marketplace? How would it interact with the new market mechanisms, such as futures, which have developed since the SPR was first designed? Would there be a major political debate about whether to "release" the oil or whether to hold onto it in case events take a turn for the worse, the result of such a debate could be confusion and indecision on the disposition of the SPR?

- Commodity Stockpiles: Some critics argue that the past history of stockpiles offers little ground for confidence in the ultimate effectiveness and efficacy of a program such as the SPR. Others respond that the SPR is meant as a *strategic* reserve not a market buffering reserve.

- Location: The SPR is concentrated on the Gulf Coast. Should there be regional storage facilities, as well?

More than anything else, what is shaping the debate over the SPR are the changes unfolding in the world oil market, and that situation provides the essential backdrop for considering the future of the SPR itself.

The Oil Market

The oil crisis of 1973 was the result of a political event -- the Arab oil embargo that accompanied the Yom Kippur War -- superimposed on a very tight world oil market. The "Second Oil Shock," 1978-80, was driven by the disruption of established supply channels, initially centered on Iran, resulting in a global panic. Following that second crisis, oil demand fell significantly around the world, initially the result of the severe recessions of 1980 and 1982 and then, more lastingly, for three additional reasons:

- a great wave of energy conservation;

- large-scale fuel switching, primarily in power generation, from oil to other energy sources, including coal and nuclear power;

- development of more diversified oil production around the world ("non-OPEC"), of which the three most important new sources were the North Sea, Mexico, and Alaska.

In the United States, the decline in oil demand, combined with an increase in domestic U.S. oil production, meant a fall in U.S. oil imports -- from a high of 8.6 million barrels per day (mbd) (46 percent of total consumption) in 1977 to 4.3 mbd in 1985 (27 percent of consumption). The OPEC countries saw their markets fall away, and with that, their share of the world oil market fell from 52 percent in 1977 to 31 percent in 1985. A considerable surplus of production capacity in excess of market demand built up throughout the world, though primarily concentrated in the OPEC countries. This contrasted with the situation in 1973, when the OPEC countries were producing virtually every barrel that they could.

The OPEC countries instituted quotas in order to maintain price. Their market share continued to shrink, particularly that of Saudi Arabia, which saw its production, which had been as high as 10 mbd a few years earlier, fall to as low as 2.5 mbd. In 1985, first Saudi Arabia and then the rest of OPEC shifted from "defending" price to regaining market share. The result was the price collapse of 1986.

Although OPEC quotas were subsequently re-established and the price raised, the price collapse has had enormous consequences. It has changed the economics of the world oil industry concurrent with a long period of economic growth. High-cost oil production has lost its ability to compete in the market. This is most notable in the United States, where oil production has fallen by 17 percent since 1985, a decline of 1.8 mbd. Alaskan output began to decline in 1989 (see Table 1 and Figure 1). U.S. oil imports are back to their late 1970s level and now account for about 45 percent of net imports. Oil production in the North Sea has been disrupted by a series of accidents that appear to be temporary and are now in the process of being remedied. Soviet oil production has also begun to fall, and this drop is beginning to show in reduced Soviet oil exports. Mexican oil production has also fallen by about 9.6 percent since 1984, and that country's oil exports by 17 percent. At the same time, strong economic growth, particularly in East Asia, has been stimulating energy demand and demand for oil.

Table 1

U.S. Petroleum Supply and Demand
(millions of barrels per day)

	Crude Oil			Net	
	Lower 48	Alaska	NGLs	Imports	Demand *
1973	9.0	0.2	1.7	6.0	17.3
1974	8.6	0.2	1.7	5.9	16.7
1975	8.2	0.2	1.6	5.8	16.3
1976	8.0	0.2	1.6	7.1	17.5
1977	7.8	0.5	1.6	8.6	18.4
1978	7.5	1.2	1.6	8.0	18.8
1979	7.2	1.4	1.6	8.0	18.5
1980	7.0	1.6	1.6	6.4	17.1
1981	7.0	1.6	1.6	5.4	16.1
1982	7.0	1.7	1.6	4.3	15.3
1983	7.0	1.7	1.6	4.3	15.2
1984	7.2	1.7	1.6	4.7	15.7
1985	7.1	1.8	1.6	4.3	15.7
1986	6.8	1.9	1.6	5.4	16.3
1987	6.4	2.0	1.6	5.9	16.7
1988	6.1	2.0	1.6	6.6	17.3
1989	5.8	1.9	1.5	7.1	17.2

Source: U.S. Department of Energy.
Notes: *Demand includes stock changes, refinery gains and losses, and LPGs.

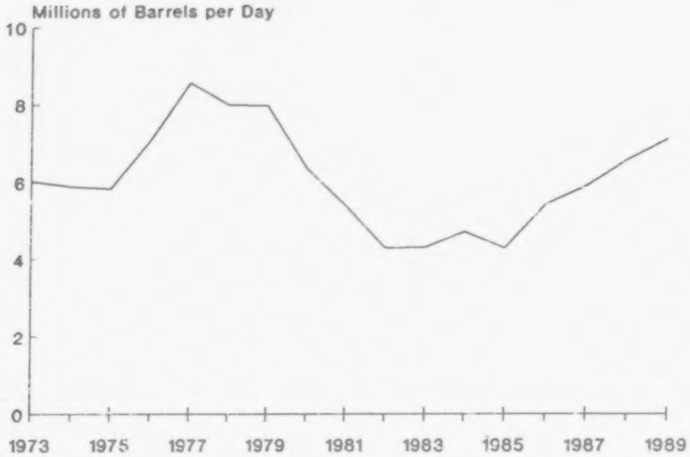
The result has been a shift back to OPEC. The production by that group of exporters has risen from 16.1 mbd in 1985 to 21.7 mbd in 1989 and in excess of 23 mbd today. It is generally thought that OPEC's total production capacity is somewhere between 26 and 28 mbd, having deteriorated over the 1980s. This means that OPEC is currently producing at around 85 percent of its capacity -- more like the situation in the early 1970s than in the mid-1980s (see Figure 2). There is virtually no short-term spare production capacity outside of OPEC. Such a high rate of production does not leave a great "security margin" for accidents and the "unexpected" -- which have become a feature of the world oil market since the beginning of the 1970s -- or indeed for further rises in demand over the next few years.

Five points emerge from these observations:

1. OPEC: Security of Demand. The orientation of most OPEC countries toward their customers, primarily in the U.S. and the other industrial countries, is quite different going into the 1990s than it was going into the 1970s. The emphasis today for the

Figure 1

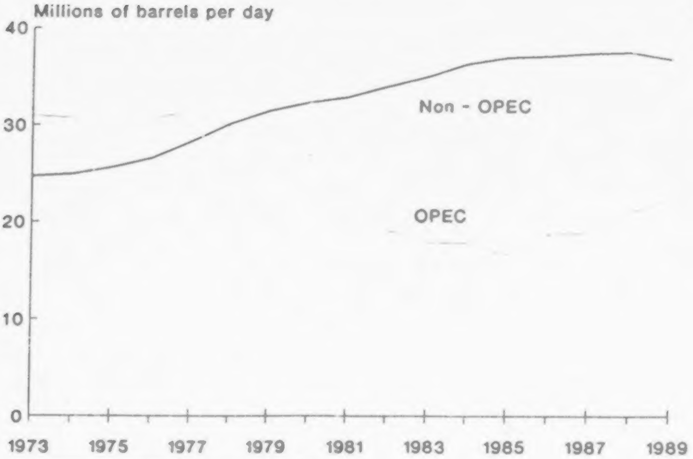
U.S. Petroleum Net Imports



Source: Cambridge Energy Research Associates.

Figure 2

World Crude Oil Production



Source: Cambridge Energy Research Associates.

exporters is on "security of demand" -- long-term markets, where demand will be met by reliable suppliers. The exporters saw their markets shrink before their eyes in the 1980s, and they do not want to repeat that. Thus, a number of exporters currently see their interests best served by "moderate," rather than high prices.

2. The Market: Accident Prone. A tight market, however, is one vulnerable to shocks. Customarily one looks at the Middle East for such shocks, but they could arise elsewhere as well, such as a perturbation in Soviet oil production or a serious environmental problem. The market is also exposed to short-term volatility due to unexpected incidents and accidents at oil production facilities worldwide. The market response to a problem could well be a sharp price spike, and such a response could come more swiftly than in the 1970s, because of changes in the structure of the market. Indeed, the spike in heating oil prices this past winter demonstrates how the weather can, at least in the short term, trigger a sharp response in the market price.

3. Market-Driven Risk Management. Owing, among other reasons, to the pressure of financial and energy markets over the past few years, the various stages of the energy supply markets are more taut, with less cushion, and thus "management" of risk may end up more in the marketplace and less within companies.

4. Price and Conservation. Future prices and the expectation thereof will have effects on demand, though the timing and extent is uncertain. A decade ago, it was obvious that there was tremendous conservation potential, for instance, in the United States. Today, the United States uses 22 percent less energy per dollar of GNP than it did in 1979, and 29 percent less than 1973. The extent of the readily-available conservation potential in the industrial countries is less clear today, and many developing countries are at a stage where rising incomes means rising energy consumption.

5. The Production Capacity Race. Growing demand and rising prices will elicit a supply response, both from non-OPEC producers and, critically, from OPEC countries. Over the past few months eyes have turned to the subject of capacity additions in the OPEC countries. There is now much discussion about adding of new production capacity. But there are many questions. Who will add that capacity? Who will pay for it? How will it be paid for? And when? Timing is a critical question. Capacity increases in at least nine of the OPEC countries could total as much as 5 to 6 mbd by the mid-1990s. In a very real sense, the most important driving force in the world oil markets during the 1990s may be the race between OPEC production and OPEC capacity.

In a tightening market, the salience of the SPR increases and its significance and importance to U.S. interests increases.

Of Stockpiles and Storage

The strategic danger of a disruption of oil supplies first became apparent on the eve of World War I, when Winston Churchill as First Lord of the Admiralty, converted the Royal Navy from coal to oil. This was the first of many occasions when a government of an oil-importing country pursued policies of building up strategic reserves -- that is, oil in government-owned or government-controlled storage that could be used in an emergency. There has always been, as there is today, the question of how much is enough. Marcus Samuel, the founder of Shell Transport and Trading and a leading proponent of Churchill's decision to convert to oil, argued, "You cannot have too much storage -- I do not think you can go too far in that." Budget-conscious treasury departments usually tend to disagree. The nature of vulnerability was, however, brought home during the First World War, in 1917, when the entire British and French military operations were threatened by a serious oil shortage, resulting from German interdiction of shipments from the United States to Europe through submarine warfare. In the interwar years, as oil became more crucial to the efficacious use of military force, various governments pursued programs in an attempt to build up strategic stocks. Any such concerns faded, however, in the United States during the 1930s, owing to the glut arising from the great discoveries in East Texas and elsewhere.[1]

World War II led to renewed attention on ensuring sufficient supplies in time of a crisis. This was part of a larger focus on import dependence for critical raw materials. The first stockpile legislation (for minerals) in the United States was passed in 1939.[2] In the years immediately following World War II, some proposed a conscious policy to increase petroleum imports from the Middle East in order to maintain a strategic reserve of unused production capacity in the Western Hemisphere that could be used in a crisis. In 1948, the U.S. National Security Resources Board argued that the U.S. should step up imports of Middle Eastern oil in order to allow a million barrels per day of Western Hemisphere production to be shut in, in effect creating a military stockpile in the ground -- "the ideal storage place for petroleum," it said. In its review of commodity policies, the Paley Commission recommended in 1952 the establishment of a strategic reserve for oil. After the 1956 Suez Crisis, President Eisenhower suggested that the U.S. government build up its own emergency oil reserves. The idea was considered wholly impractical. A similar recommendation was made by the Cabinet Task Force on Oil Import Control, chaired by George Shultz, in 1970, though without effect. At about the same time, the Shah of Iran -- keen to increase his country's output and thus its revenues -- offered to provide the United States with a million barrels per day for 10 years, at a dollar per barrel, that could be stored in salt domes. The United States did not accept the offer.[3]

But, in fact, the United States did already have a "strategic reserve." This was the production capacity "shut-in" by the Texas Railroad Commission and similar agencies in other states. It was not shut-in for strategic reason but rather, officially on grounds of "conservation," with the *de facto* effect of maintaining higher prices for domestically produced oil. In the series of postwar oil crises -- 1951, 1956, 1967 -- this "shut-in" production was called into operation, and provided the critical alternative supplies that muffled the crises (see Table 2). But, by the beginning of the 1970s, there was no longer any shut-in capacity in the United States; the country's oil industry was producing flat-out. The United States reached its historic peak as an oil producer in 1970 and then began to decline; the old quota system broke down; and the U.S. became increasingly dependent upon imported oil. What this meant was that the "security margin," which had been instrumental in managing previous crises, was no longer there.[4]

In essence, today the Strategic Petroleum Reserve is meant to assume the place formerly held by the shut-in production capacity in the United States and so provide what is perceived to be the requisite security margin.

The Establishment of the SPR

Provision for the SPR was contained in the Energy Policy and Conservation Act (EPCA), which was signed into law in December 1975. (This was the same legislation that provided for the automobile fuel efficiency standards.) The declared objective was to establish the reserve in order to reduce the effect of disruptions in petroleum supplies and to carry out the obligations of the

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[1] Daniel Yergin, *The Prize: The Epic Quest for Oil, Money, and Power*, (New York: Simon and Schuster, 1990).
[2] Raymond Vernon, *Two Hungry Giants: the United States and Japan in the Quest for Ore and Oils*, (Cambridge: Harvard University Press, 1983).
[3] Daniel Yergin, *The Prize*.
[4] Daniel Yergin, "Energy Security for the 1990s," *Foreign Affairs*, Autumn 1988.

Table 2

World Oil Supply Disruptions
Percent of World Oil Consumption
1951-1989

Dates	Supply Disruption	Magnitude of Supply Shortfall (mmb/d)	World Oil Consumption (mmb/d)	Percent of Consumption
March 1951-October 1954	Iranian Fields Nationalized	0.7	13.22	5.30
November 1956-March 1957	Suez War	2.0	17.5	11.43
December 1966-March 1967	Syrian Transit Fee Dispute	0.7	34.3	2.04
June 1967-August 1967	Six Day War	2.0	40.0	5.00
July 1967-October 1968	Nigerian Civil War	0.5	40.1	1.25
May 1970-January 1971	Libyan Price Controversy	1.3	48.0	2.71
April 1971-August 1971	Algerian-French Nationalization Struggle	0.6	50.2	1.20
March 1973-May 1973	Lebanese Political Conflict	0.5	58.2	0.86
October 1973-March 1974	October Arab-Israeli War	1.6	58.2	2.75
April 1976-May 1976	Civil War in Lebanon	0.3	60.2	0.50
May 1977	Damage at Saudi Oilfield	0.7	62.1	1.13
November 1978-April 1979	Iranian Revolution	3.7	65.1	5.68
October 1980-January 1981	Outbreak of Iran-Iraq War	3.0	60.4	4.97
July 1988-November 1989	UK Piper Alpha Offshore Platform Explosion	0.3	49.8	0.60
December 1988-March 1989	UK Fulmer Floating Storage Vessel Accident	0.2	51.6	0.39
April 1989-June 1989	UK Cormorant Offshore Platform	0.5	51.6	0.97

Source: U.S. Department of Energy

United States under the agreement among the western nations on an International Energy Program (IEP).

The IEP was signed as part of the U.S. membership in the International Energy Agency (IEA). The IEA is a semi-autonomous organization, related to the Organization for Economic Cooperation and Development (OECD). Its purpose is to help coordinate energy policies and positions of the western industrial countries, promote energy security broadly-defined, and prevent destructive mercantalist policies among member nations. Among other things, the IEA provides a framework for coordinating emergency stock programs among western countries. The IEA has repeatedly emphasized the role of oil stocks (i.e., inventories). For instance, its 1984 "Decision on Stocks and Supply Disruptions," stressed the role of emergency oil stocks in offsetting short-term supply disruptions, moderating the resulting price increases, and mitigating economic damage. This commitment has been reiterated by the IEA Governing Boards -- at the ministerial level -- in 1985, 1987, and 1989.

In essence, five dominant perceptions have shaped policy on stocks among the western industrial countries:

- Disruptions can reoccur.
- Disruptions can cause serious disorder in national economies and societies and engender grave tensions within societies and among the western countries.
- Disruptions, combined with sudden price increases, can cause serious and even grave macroeconomic difficulties, measured in terms of inflation and recession.
- Disruptions or shortages can have negative military implications.
- The possibility or actuality of disruption and manipulation of oil supplies for political purposes can put western countries into unacceptable foreign policy positions.

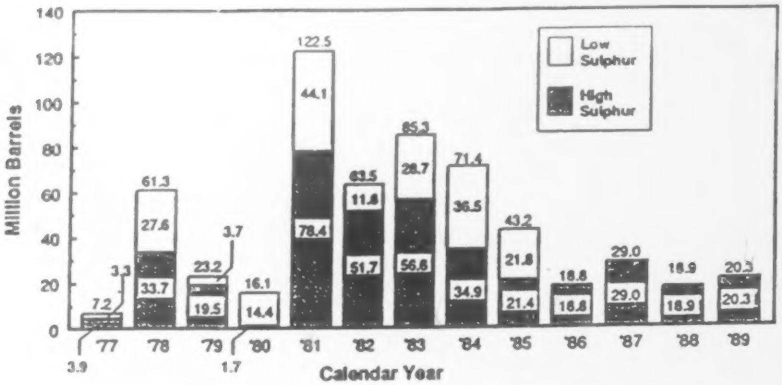
Thus, emergency stocks like the SPR are meant to help manage and reduce the effects of such risks -- and, indeed, to serve as a deterrent.

The IEA's commitment is for countries to maintain, in one form or another within their borders, the equivalent of 90 days of the previous year's net imports in the form of oil stocks. This can be any mixture of company stocks, government-controlled stocks, or government-owned stocks. In many countries, there are mandatory requirements for oil companies to maintain specific levels of stocks. This is not the case in the United States. In addition to the United States, only Japan and Germany have substantial government-owned and operated strategic petroleum reserves. Nevertheless, several other West European countries maintain relatively high levels of inventories when measured in terms of days of net oil imports. Altogether, the United States has about 200 days of imports coverage from the SPR and commercial stocks combined. However, 75 to 90 percent of the commercial stocks are considered essential to keep the far-flung U.S. oil supply system functioning (see Appendix Tables 1, 2, and 3).

In the course of establishing the U.S. SPR, salt domes were identified as the preferred setting for storage. The logical choice for such storage was along the U.S. Gulf Coast, where more than 500 salt domes are located, and it is also the logistical center for tankers, barges, pipelines, refineries, and distribution points. Acquisition of the first storage sites began in Louisiana and Texas in 1977, and in that year the "fill" began (see Figures 3 and 4).

Figure 3

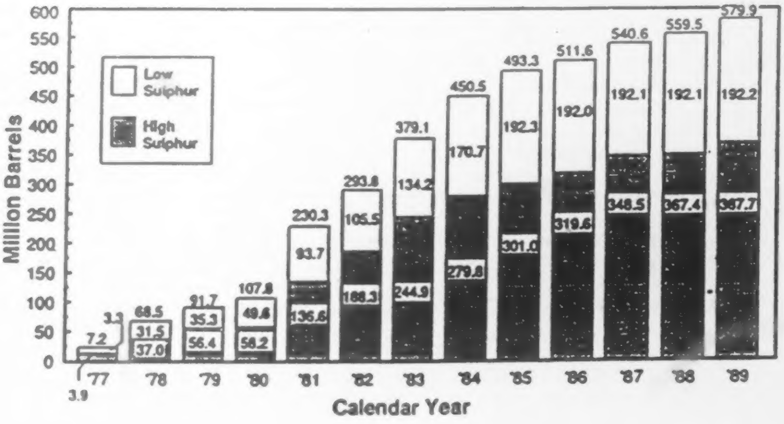
Annual Strategic Petroleum Reserve Oil Fill



Source: U.S. Department of Energy.

Figure 4

Cumulative Strategic Petroleum Reserve Oil Fill



Source: U.S. Department of Energy.

Current Policy

In accord with current law and policy, the Department of Energy (DOE) is developing the Strategic Petroleum Reserve with the following characteristics:

- The U.S. government owns, controls, and manages the SPR facilities and the oil inventory.
- Crude oil is the commodity stored. The technical specifications are in accord with those of U.S. refiners.
- The crude oil is acquired through market-like methods, which have included a mix of short-term contracts with prices reflecting market conditions.
- The inventory is to be stored in salt caverns at six sites in Louisiana and Texas, connected by DOE-owned pipelines to the commercial crude oil distribution system.
- The SPR is financed through the normal Federal budget process, with the DOE doing the budgeting. To the extent that debt proceeds, rather than taxes or other current income, are used to finance the Reserve's costs, the Treasury Department arranges for the sale and servicing of the debt; interest costs on this debt are reflected in appropriations to the Treasury Department.
- The President is authorized to decide whether, how, and when the SPR inventory is to be sold, under the broad criteria in the EPCA and as amended.
- The Secretary of Energy, through an "SPR Plan" -- which includes a distribution plan and which is transmitted to Congress -- prescribes the mode of storage and drawdown.
- Under current plans, the primary method for distributing the SPR is through competitive sales.
- The SPR inventory target is currently set at 750 million barrels.

How Is the SPR Organized?

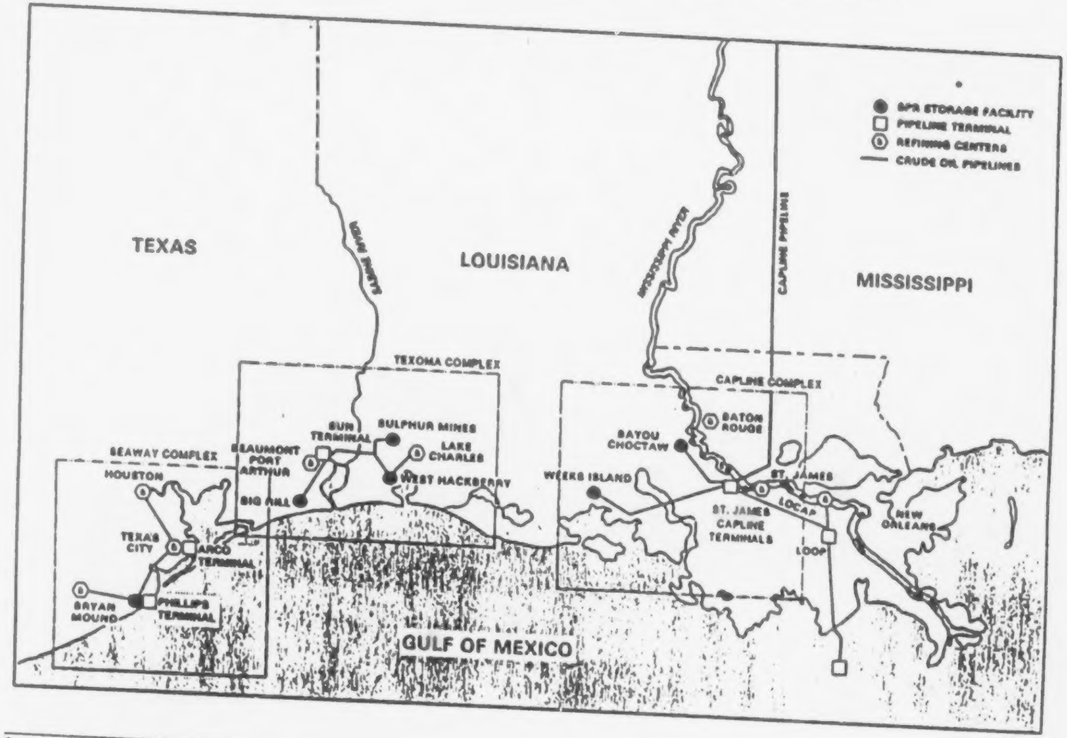
The system is composed of six underground crude oil storage facilities in salt domes along the Gulf Coast, plus a government-owned marine terminal on the Mississippi River at St. James, Louisiana (see Figure 5). These six sites are organized into three distribution systems and are connected by DOE pipelines to commercial crude oil pipeline networks and government-owned marine terminal distribution centers. Of the total stockpile, 67 percent is high sulfur (sour) and 33 percent is low sulfur (sweet).

How much oil could be withdrawn from the system today? The current drawdown and distribution capability is 3.5 mbd (see Figure 6). This is roughly equivalent to 40 to 45 percent of current import levels. After 90 days, the drawdown rates would decrease gradually as various site inventories deplete and a declining number of remaining caverns containing crude oil become a constraint on the sites' drawdown rates.

The current program is aimed to raise the storage from its 580 million barrels at the beginning of 1990 to 750 million barrels and the drawdown/distribution capability to 4 mbd.

Figure 5

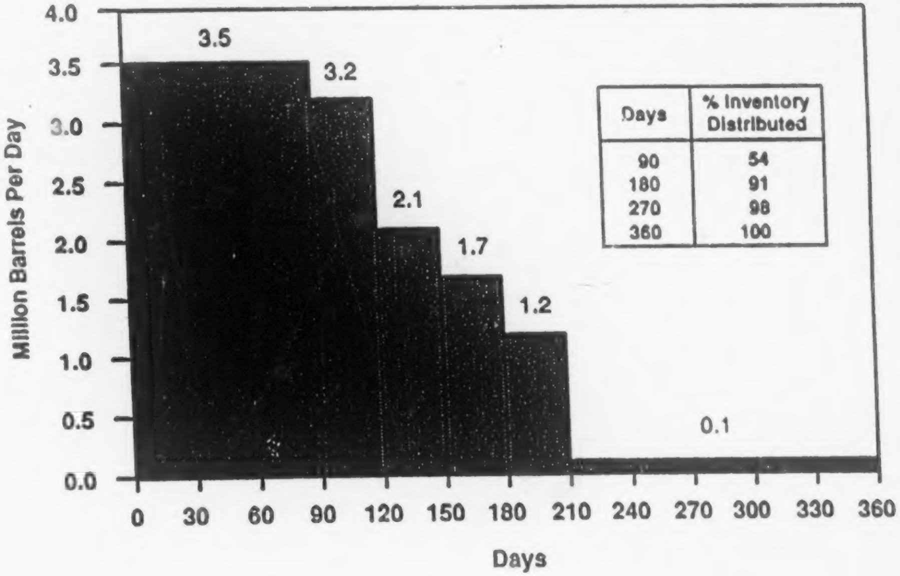
Strategic Petroleum Reserve Complexes and Associated Pipelines and Terminals


● SPR STORAGE FACILITY
□ PIPELINE TERMINAL
⊙ REFINING CENTERS
— CRUDE OIL PIPELINES
TEXAS
LOUISIANA
MISSISSIPPI
SABINE RIVER
MISSISSIPPI RIVER
CAPLINE PIPELINE
TEXOMA COMPLEX
CAPLINE COMPLEX
SEAWAY COMPLEX
HOUSTON
TEXAS CITY
ARCO TERMINAL
BRYAN MOUND
PHILLIPS TERMINAL
BEAUMONT PORT ARTHUR
BIG HILL
SUN TERMINAL
SULPHUR MINES
LAKE CHARLES
WEST HACKBERRY
WEEKS ISLAND
BAYOU CHOCTAW
BATON ROUGE
ST. JAMES
LOCAP
ST. JAMES CAPLINE TERMINALS
LOOP
NEW ORLEANS
GULF OF MEXICO

Source: U.S. Department of Energy.

Figure 6

Strategic Petroleum Reserve Drawdown/Distribution Capability Inventory as of 12/31/89



Days	% Inventory Distributed
90	54
180	91
270	98
360	100

Source: U.S. Department of Energy.

And What Does It Cost?

Table 3 and Figures 7 and 8 show the SPR appropriations from 1976 through 1990, totalling $19.7 billion. These appropriations are broken down into three categories:

1) Petroleum acquisition and transportation -- $16.2 billion (of which $15.8 billion was for oil and the rest for transportation).

2) Storage facilities development and operation -- $3.2 billion.

3) Management -- $235 million.

Future costs, of course, will depend on future decisions about the size, fill rate, and financing alternatives -- and the oil price itself. Under current projected budgets and plans, the 750 million barrel target would be achieved by mid-1999 (with fill rates of 39,0000 barrels per day in fiscal year (FY) 1990, 59,000 barrels per day in FY 1991, and 50,000 barrels per day thereafter). Under the FY 1991 budget request, the estimated total cost by 1999 for the development, operation, and management of the reserve is $5.1 billion. Based upon the oil price scenario used in the FY 1991 budget request, the additional oil would cost $19.5 billion.

Where and How is the Oil Acquired?

The crude oil in the SPR comes from foreign and domestic sources. The SPR has acquired crude oil from:

- purchases on the international spot market;
- long-term (one year or longer) contracts with domestic and foreign suppliers;
- special sales arrangements for oil from government-owned oil fields.

About 40 percent of the current supplies in the SPR has been purchased from Mexico. This includes a one billion dollar advance payment purchase made as part of the emergency rescue program for Mexico in 1982 when that country teetered on bankruptcy and loan default. Most of the Mexican oil has been purchased, however, on one to two year contracts, typically calling for 50,000 to 65,000 barrels per day. Prices for each delivery are based on a composite of prices for several domestic crude and heating oils.

Drawdown and Distribution

Drawdown relies on the fact that crude oil floats on top of water. To withdraw oil from a storage cavern, site operators would inject fresh water into the cavern, forcing the crude out of the top of the cavern and through piping to the surface. After passing through metering stations, the oil would be transported by pipelines to terminals, which in turn are tied into the nation's commercial oil transport network. From that point, the oil would either go by pipelines to local refineries or loaded into tankers and barges for transportation to other parts of the country.

But will this system work? As part of the SPR's development, there is frequent testing of equipment and personnel to ensure that the SPR is in a constant state of readiness. Drawdown tests are run at all sites to ensure that oil can be withdrawn from the storage caverns. The first test was conducted at the West Hackberry site in February 1980. Since 1983, actual or simulated drawdown tests have been conducted regularly at different SPR sites. The equipment tests have

Table 3

Strategic Petroleum Reserve Appropriations

(thousands of dollars)

Fiscal Year	Petroleum Acquisition and Transportation	Storage Facilities Development and Operations	Management[1]	Total
1976	0	300,000	13,975	313,975
1977	440,000	0	7,824	447,824
1978	2,703,469	463,933	14,704	3,182,106
1979	2,885,670	103,290	18,111	3,007,071
Reprogramming	(529,214)	529,214	0	0
	2,356,456	632,504	18,111	3,007,071
1980	(2,000,000)[2]	0	0	(2,000,000)
Reprogrammings:				
Number 1	(20,391)	0	20,391	0
Number 2	(1,881)	0	1,881	0
	(2,022,272)	0	(22,272)	(2,000,000)
1981	2,688,282[3]	82,834	19,391	2,790,507
Entitlements	542,146	0	0	542,146
Reprogrammings:				
Number 1	(18,000)	18,000	0	0
Number 2	(7,334)	7,334	0	0
	3,205,094	108,168	19,391	3,332,653
1982	3,684,000	171,356	20,076	3,875,432
Reprogramming	(4,300)	4,300	0	0
	3,679,700	175,656	20,076	3,875,432
1983	2,074,060	222,528	19,590	2,316,178
1984	650,000	142,357	16,413	808,770
1985	2,049,350	441,300[4]	17,890[4]	2,508,740
1986	0	94,015	13,518	107,533
Reprogramming	(12,964)	12,964	0	0
	(12,964)	106,979	13,518	107,533
1987	0	134,021	13,412	147,433
1988	438,744	151,886	12,276	602,906
1989	242,000	160,021	13,400	415,421
1990	437,147	179,530	12,953	629,630
Total Appropriations	**$16,240,984**	**$3,218,683**	**$235,805**	**$19,694,672**

Source: U.S. Department of Energy.

Notes:

[1] Excludes funds appropriated to other DOE accounts but used to finance aspects of SPR program management.

[2] Rescission.

[3] Included supplemental appropriations of $1,305,000,000.

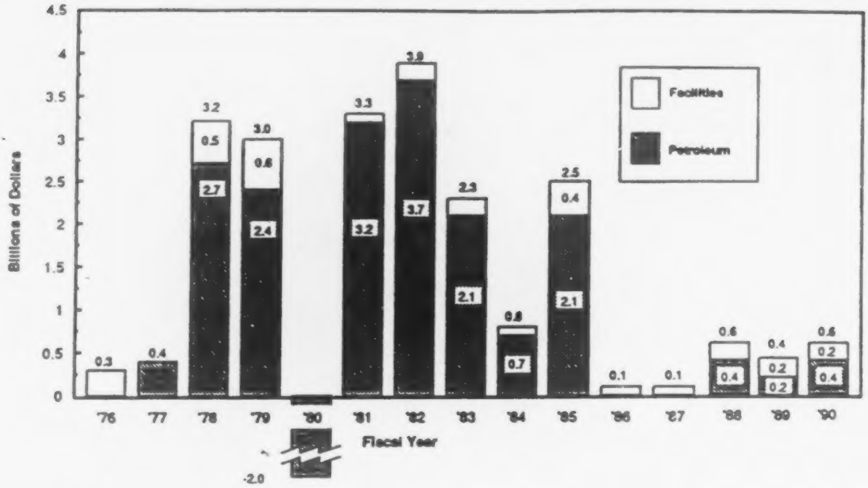
[4] Included in FY 1984 second supplemental appropriations.

[5] Includes indefinite appropriation estimated at $120,000,000.

Figure 7

Strategic Petroleum Reserve Annual Funding

Storage Facilities Development/Operations and Petroleum Acquisition/Transportation

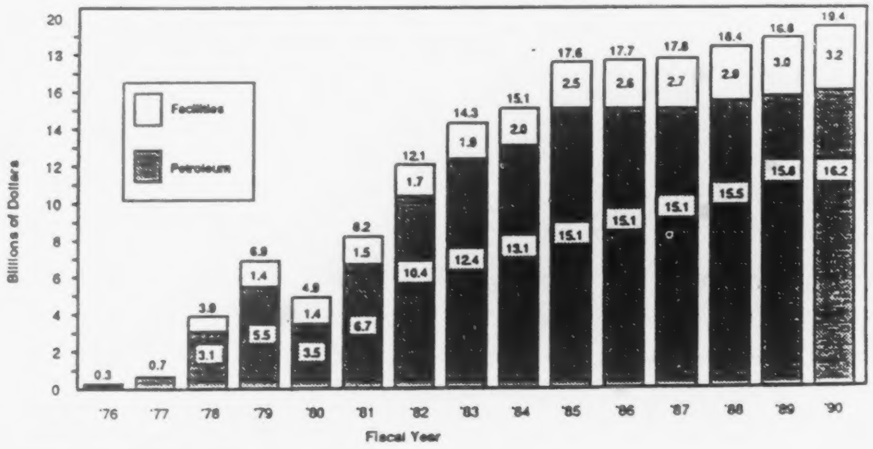


Source: U.S. Department of Energy.

Figure 8

Strategic Petroleum Reserve Cumulative Funding

Storage Facilities Development/Operations and Petroleum Acquisition/Transportation



Source: U.S. Department of Energy.

included the transport of oil to terminals. Some have involved simultaneous drawdowns at different sites. Others have included planned power failures to ensure that the system can operate on backup diesel-powered pumps.

Tests of the bidding and distribution system have also been conducted. While most have simulated the sales process, in 1985 and 1986 DOE carried out an actual test sales of SPR oil to private purchasers. One million barrels of crude oil were sold in the test.

And What Would Happen?

Drawdown decisions have to be based on a host of judgments -- including the probable length of a disruption, the likelihood of subsequent disruptions, and whether there would be opportunities to refill between disruptions. The decision can also be directed towards a variety of objectives, such as to:

- supplement domestic oil supplies and thus reduce economic and social costs;
- enhance or augment national security or foreign policy goals;
- assist in meeting IEP and other commitments.

The governing legislation provides that use of the SPR cannot be made unless the President finds such actions are required due to "a severe energy supply interruption or by obligations of the U.S. under the International Energy Program." In turn, a "severe energy supply interruption" is defined as a national energy supply shortage that:

- is or could be of significant scope and duration and of an emergency nature;
- could cause major adverse impacts on national safety or the national economy;
- results from a interruption in the supply of import petroleum products, or from sabotage, or an act of God.

The International Energy Program includes a provision under which, in an emergency, a sharing of available supplies would be worked out among the IEP member countries. The existence of these IEP obligations can serve as basis for authorizing an SPR drawdown, but there is no obligation to use the SPR specifically to meet any international sharing obligations.

The principal method of distribution of SPR oil is meant to be price-competitive sales, with the oil going to the highest bidder, and with the sales open to all interested buyers. However, the Secretary of Energy can direct sales to specific buyers up to 10 percent of total SPR oil sold during any given month.

Only the President can actually authorize a drawdown. But the general policy is "early release" -- that is, to get the supplies out into the market early on in a crisis, or even in anticipation of a crisis before it actually occurs ("early release" has also been accepted by Germany and Japan). The sales process in the United States itself involves four primary steps:

- issuance of notice of sale;
- receipt of bids:
- selection of successful bidders;

- delivery of oil.

It is thought that a sales cycle, running from Presidential authorization to the start of oil delivery, can be accomplished within three weeks.

Principal Issues of Discussion

(A) Size

With rising imports, the number of days of forward cover has been declining (see Figure 9). In the current reauthorization period, the leading issue of debate concerns the size of the SPR. The Administration's position is that 750 million barrels is the appropriate target; others say that one billion barrels is a more appropriate objective. This was a major subject of discussion in hearings held before the Senate Energy Committee on March 20, 1990.

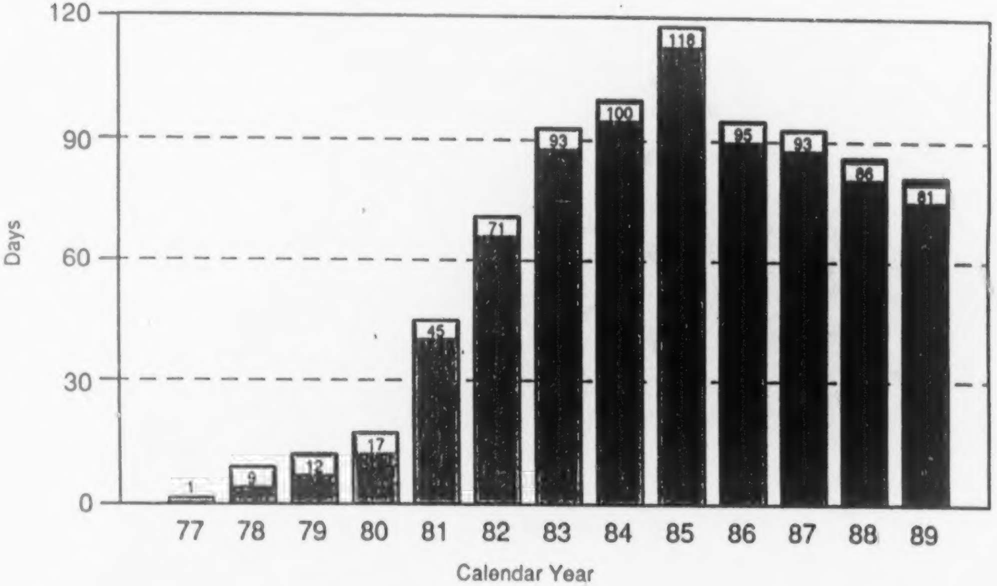
Robert H. Gentile, Assistant Secretary of Energy for Fossil Fuel, summarized the results of a new study by a U.S. government Interagency Working Group on "size options" for the SPR. Mr. Gentile made the following points:

> "The Administration believes that the development of a 750 million barrel SPR is an appropriate and prudent oil stockpiling policy for the United States. . . . The United States possesses the world's largest government-owned petroleum stockpile. The SPR is also one of the largest direct investments by the federal government in the energy sector, and serves both as a powerful deterrent against oil supply disruptions and as an effective instrument to minimize damage to the economy if such disruptions should occur. The question before the Congress and the Administration, therefore, is not one of whether to have a large SPR; we have one. Rather, the question is whether expanding the SPR beyond 750 million barrels is necessary or justified...
>
> "Expansion beyond the 750 million barrel goal would be inconsistent with current understanding of market and geopolitical conditions and of their evolution during the last decade. Such an expansion would also require a diversion of public spending from other DOE programs that also enhance United States energy security . . . It would also aggravate budgetary constraints, increase U.S. oil imports (purchases of SPR oil) that add to trade imbalances, and possibly serve as a disincentive to the expansion of strategic reserves held by our allies...
>
> ". . . expansion of the Reserve beyond the planned level of 750 million barrels is neither cost effective nor likely to measurably affect United States energy security. A key finding of the size study is that the incremental benefits of increasing the SPR from 750 million barrels to one billion barrels are far outweighed by the additional costs . . . The coordinated use of (IEA member states strategic stockpiles) would provide protection against a range of worst-case disruptions of a magnitude significantly greater than any disruption experienced in the last 40 years.
>
> "Today, we are substantially better prepared to deal with an oil supply interruption than we were in 1979. By the end of 1990, there will be the potential to offset, for six months, a loss of between 8 and 13 million barrels per day of oil supply, or a maximum of 25 percent of Free World oil consumption, assuming all excess capacity, including that in the Middle East, is used. The U.S. SPR alone will provide the capability to offset, barrel for barrel, and for six months, an interruption of 3 million barrels per day. IEA government controlled stocks would add, if necessary, an additional minimum of 2 million barrels per day. Fuel switching and potential incremental supplies from excess

Figure 9

Days of Net Import Protection

SPR Inventory (Year End)
Net Petroleum Imports (Year Avg.)



Source: U.S. Department of Energy.

world production capacity would provide offsets of between 4 and 7 million barrels of oil."[5]

At the same hearings, Philip K. Verleger, a Visiting Fellow at the Institute for International Economics, offered a critique of the interagency study. He said that it is unrealistic to expect that "world supplies can be cut by a full 20 percent without having any impact on oil prices," and that in oil market disruptions, "oil exporting countries having surplus capacity immediately increase production to replace lost supplies at the predisruption price. These Santa Clauses are aided by other holders of stocks so that the oil in the strategic reserve can be used last." Verleger also argued that "changes in the structure of world oil markets will have [major effects] on the market during the next crisis. These changes, . . . the 'commodization' of the oil market, require that consuming governments hold larger stocks and be ready to use them more rapidly."

Verleger cites the sharp gasoline price increases following "the very minor interruption in supply associated with the Exxon Valdez incident" and the doubling of heating oil prices this past winter. "These two episodes contain a lesson for energy planners. Prices should be expected to increase rapidly at the outset of a crisis, not remain at predisruption levels as predicted by the Working Group. Further, prices will remain high until the lost supply is restored. Evidence from other markets indicates that these increases will occur even if the level of supply is maintained at predisruption levels because expectations of buyers and sellers are fundamentally changed by the event that triggers the crisis." Thus, he says, there is a need to be prepared "to meet the psychological " as well as "physical effect of a crisis. This would require the agency plan to use the Strategic Reserve first and agree to supply oil in sufficient volumes to offset both the loss of supply and the increased demand for stocks. In short, DOE must plan to flood the market with oil if it is going to prevent prices from increasing."[6]

(B) Cost

Various proposals have been put forward for SPR financing, including the addition of a small "user's fee" in the form of an addition to the current gasoline tax. Recently, however, attention has centered on lowering the acquisition cost for the SPR by leasing, rather than buying oil. The idea is that the United States would "lease" or "rent" oil from a country like Saudi Arabia that has surplus capacity. To be effective, the U.S. would be leasing the oil at below market rates. It might or might not acquire ownership at the end of the period. In the meantime, however, the U.S. government would have complete control over disposition of the leased oil in the reserve. The advantages for the exporting country are two-fold: it would be gaining additional revenues that, otherwise, it would not be receiving; and the act of leasing would demonstrate the particular country's intention to be a reliable supplier and its opposition to sudden and destabilizing price increases and shocks.

Under one proposal, the United States would be leasing oil from a producer at an annual fee of, say, 5 percent of the current market value -- which, at $20 per barrel, works out at $1 per year. Subsequent payment would only be made when and if the leased oil was actually used by the United States.

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[5] Robert H. Gentile, Statement before the Committee on Energy and Natural Resources, U.S. Senate, March 20, 1990.

[6] Philip K. Verleger, Statement before the Committee on Energy and Natural Resources, U.S. Senate, March 20, 1990.

(C) Other Pro's

Several other arguments are advanced *in support* of the SPR:

- It provides foreign policy flexibility in reacting to events affecting world oil supplies. The SPR buffer buys time for U.S. policymakers to pursue measured options as opposed to being forced to more severe reactions.
- The existence of the SPR serves as a deterrent to any producers considering political/economic actions that would deny supplies to the world market: those producers would pay a price -- foregone sales revenue.
- A large and effective SPR tends to counteract calls for protectionist measures for domestic energy production.
- The SPR can influence market psychology and tend to be a stabilizing force during an oil supply interruption. An announcement by the President or Secretary of Energy that the SPR will be used promptly and at a high rate could have a calming effect on a volatile market and, in particular, would make would-be hoarders think twice about the economic consequence of their adding to their own inventories and would warn off speculators.

(D) Con's

One further argument relates to a change in the behavior of oil companies. They have progressively lowered their own holdings. This is the result of several factors:

- Market conditions, combined with the pressure of the financial markets for quarterly performance, have caused companies to cut inventories in order to reduce costs.
- Price volatility has meant that companies want to avoid inventory risks.
- Companies have increasingly sought to cover their market risk with futures instead of physical inventories.

Thus, there is less cushion in private inventories in a supply crunch, and more of a need for the SPR (see Figure 10).

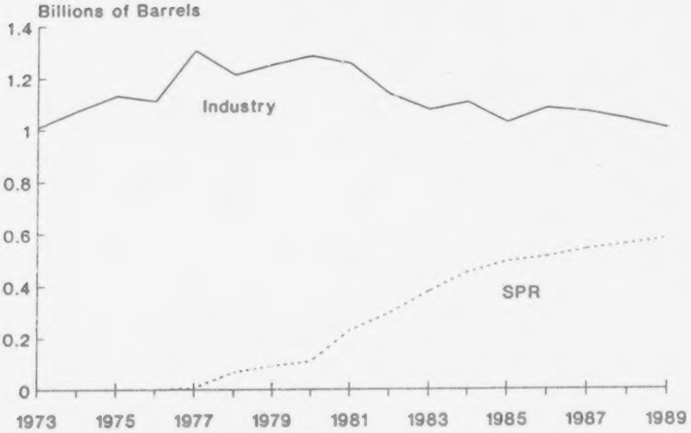
There are also several additional arguments *against* the SPR and questions about how it would work.

One centers on the character of the American political system. The declared policy is one of "early release." But some believe that, in real life, there would be a fractious and angry policy debate involving the "early releasers" in conflict with the "doubters," who question the reality of a crisis and suspect oil company manipulation, and the "hoarders," who, uncertain as to what is ahead, want to hold onto the oil in the reserve. The result might well be indecision, delay, and confusion, with the result that the SPR would be used too late to be effective, if used at all. And one can certainly conceive of situations where market conditions result in price spiking, prompting calls for use of the SPR by some, while others say that the market will correct itself. However, the general view in the U.S. (and other Western governments), is that the SPR is for *strategic* purposes, and not a *buffer stock* for smoothing out price fluctuations -- the experience of which with other commodities has been poor.

Figure 10

U.S. Primary Petroleum Stocks

Year End Inventories



Source: Cambridge Energy Research Associates.

Others believe that the general record of commodity stockpiles is not very encouraging. Whatever the intent of the SPR, they say, there has been a chronic confusion concerning stockpiles as to whether the purpose of the stockpile is strategic or to serve as a buffer and stabilizing mechanism, or whether they really end up as a way to subsidize certain producers. They are concerned that this could end up the fate of the SPR.

It is also argued that the current oil market structure makes the SPR in its current configuration and use policy largely irrelevant and somewhat obsolete. With the existence of the futures and futures markets, the dominance of market-related pricing contracts, and the large number of wholesalers and distributors, the market would react too quickly and prices would rise too sharply for the SPR to have its intended effect. In other words, it would end up being too little, too late. In addition, it is said in support of this position that even if SPR supplies were sold quickly, there is no mechanism for assuring they would actually reach end-users. During a real or perceived supply interruption, inventories might be husbanded because of rising price expectations. So SPR oil might just go from salt domes into steel tanks.

Finally, there is a broad macroeconomic debate that underlies some discussion of the SPR. For the most part, it is believed that the two oil crises of the 1970s delivered grave macroeconomic shocks, as measured in inflation and recession, and that therefore a driving reason for such energy security measures as the SPR is to prevent future economic shocks. The SPR is, in effect, an insurance premium on the gross national product. And, since the house has already been burned down twice in recent times, there is good reason to keep up the premium. A minority view, however, holds that the problems of the 1970s were not the result of the oil shocks but rather of poor monetary policy; and that, therefore, if the management of monetary policy and economic policy in general is improved, there is little likelihood of a new shock. That being the case, greater effort should be put into improving the competence of economic management rather than into the building up of a Strategic Petroleum Reserve.

New Calculus

One fact is central. A substantial SPR now exists, which was not the case a decade ago, and it adds a new and more explicit meaning to the concept of the security margin and establishes a new calculus for considering the dynamics of crises that lie ahead.

APPENDIX 1

Stocks on Land in IEA Countries as of July 1, 1989

(million of barrels or "days")

	Company	Strategic (Public)		Total Access	Days 88
Net					
Country	Stocks	Stocks	MOR*	Stocks	Imports
Australia	34	0	18	16	**
Austria	16	3	4	15	94
Belgium	34	0	12	21	88
Canada	115	0	86	29	**
Denmark	22	13	7	28	373
Germany	93	191	83	200	126
Greece	33	0	11	22	146
Ireland	6	0	2	4	76
Italy	149	6	58	97	101
Japan	355	188	157	385	119
Luxembourg	2	0	1	1	77
Netherlands	40	15	35	20	192
New Zealand	7	0	4	3	187
Norway	26	0	8	18	**
Portugal	20	0	9	12	109
Spain	59	0	37	22	74
Sweden	43	1	7	37	141
Switzerland	39	0	4	36	147
Turkey	19	0	9	10	47
U.K.	120	0	61	59	**
U.S.	842	565	693	715	209
IEA Total	2,074	981		1,749	
France	123	0	18	55	

Source: International Energy Agency.

Notes: *Minimum Operating Requirements.
**Net exporter or very small net importer.

APPENDIX 2

Stock Ownership and Custody

Country	Ownership	Custody
Japan	Federal reserve - government (JNOC)	JNOC -- in segregated tankage
	Compulsory stocks -- Companies	Amalgamated with commercial stocks
W. Germany	Federal reserve -- government	Government -- in segregated salt domes
	Compulsory stocks -- Mixed ● EBV owns most of its stocks ● Companies retain ownership of some EBV stocks as well as of balance of compulsory stocks	Mixed -- EBV stocks are generally held in segregated storage (tanks and salt domes). Some of the EBV stocks as well as the compulsory stocks held by companies themselves are generally amalgamated with commercial stocks
France	Compulsory stocks -- Mixed SAGESS owns some stocks and leases others ● Companies retain ownership of leased stocks as well as of balance of compulsory stocks	Mixed -- SAGESS leases tankage from companies; stocks are not necessarily segregated but may be amalgamated with commercial stocks
United Kingdom	Compulsory stocks -- Companies	Amalgamated with commercial stocks
Netherlands	Compulsory stocks -- Mixed ● COVA owns some compulsory stocks ● Companies own balance of compulsory stocks	Mixed -- COVA stocks generally segregated. Company-held compulsory stocks generally amalgamated with commercial stocks
Italy	Federal reserve -- Government	Held by ENI, state refining company, presumably segregated
	Compulsory stocks -- Companies	Amalgamated with commercial stocks
Denmark	Compulsory Stocks -- Mixed ● FDO owns its compulsory stocks ● Companies own balance of compulsory stocks	Mixed -- FDO stocks generally held in segregated tankage leased by FDO. Company-held compulsory stocks are generally amalgamated with commercial stocks

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Source: International Energy Agency.

APPENDIX 3

Stock Targets and Operations

Country	Government Stocks	Company Stocks
Japan	Current stocks are approximately 190 million barrels. The MITI goal is to have 50 million kiloliters (approx. 315 million barrels) in stock by mid-1990s.	Target: Currently 86 days of inland sales; prior to 1989, target was 90 days; may be reduced to 70 days as government stocks are increased. Obligations: Refiners – approx. 72 days of average throughput of previous year; importers – approx. 14 days of average imports of previous year; independent marketers – approx. 14 days of average sales of previous year.
West Germany	Federal reserve has been struck at 54 million barrels for 10 years. An espoused long-term goal of approximately 73 million barrels has often put forward.	Target: 90 days of inland sales. Obligations: Refiners – 90 days of average output of previous year; dependent importers – 70 days of average imports of previous year; independent imports – 40 days of average imports of previous year. Practice: EBV holds all but 15 days of refiner's obligation.
France	No government stocks.	Target: 90 days of inland sales. Obligations: Refiners and importers – stocks of principal products equal to one-quarter of previous 12 months of inland sales. Practice: Up to one-half of the total company obligations will be held by the stock company SAGESS.
United Kingdom	No government stocks.	Target: 76.5 days of inland sales. Obligation: Refiners – 76.5 days of average supply of previous year; other suppliers – 66 days of average supply of previous year.
Netherlands	No government stocks.	Target: 90 days of inland sales. Obligations: Refiners – 50 days of average sales of previous year; independent importers – 15 days of average imports of previous year; storage corporation (COVA); 40 days of refiners' obligation and 55 days of importers' obligation, plus any additional to meet IEA obligations.

APPENDIX 3
(continued)

Country	Government Stocks	Company Stocks
Italy	Current federal reserve of 800,000 tons (approx. 6 million barrels). No plans to increase size.	Target: 90 days of inland sales. Obligations: State Electric Utility (ENEL) – 30 days of average residual fuel oil consumption or 90 days average direct imports of previous year (which ever greater); unbonded storage depots – 10% of capacity; 3rd party processors – 23 days of average exports; refiners and importers – balance of national obligation, allocated based on deliveries of previous year.
Denmark	No government stocks.	Target: 125 days of inland sales of the principal products. Obligations: Refiners and importers – 125 days of average sales of the previous year. Practice: Stockholding association, FDO, holds more than two-thirds motor gasoline obligation and all of the distillate and fuel oil obligation. FDO goal is to eventually hold entire company obligation.

Source: International Energy Agency.

APPENDIX 4

Strategic Petroleum Reserve Oil Fill History

	Fiscal Year		Calendar Year	
	Year-End Inventory (million bbls)	Average Daily Fill Rate (thousand bbls/d)	Year-End Inventory (million bbls)	Average Daily Fill Rate (thousand bbls/d)
1977	1.1	3	7.2	20
1978	49.1	131	68.5	168
1979	91.2	115	91.7	64
1980	92.8	4	107.8	44
1981	199.2	292	230.3	336
1982	277.9	215	293.8	174
1983	361.0	228	379.1	234
1984	431.1	191	450.5	195
1985	489.3	159	493.3	119*
1986	506.4	47*	511.6	41*
1987	533.9	75	540.6	80
1988	554.7	57	559.5	52
1989	577.1	62	579.9	56

Source: U.S. Department of Energy.

Notes: *Fill rates unadjusted for oil deliveries under the 1985/1986 test sale.

APPENDIX 5

NAVAL PETROLEUM RESERVES

In the early part of this century, four naval petroleum reserves (NPR) were established from public lands by executive orders to assure that the U.S. navy would have adequate supplies of petroleum during wartime. The four reserves and their dates of establishment were: NPR-1, Elk Hills, California, 9/2/1912; NPR-2, Buena Vista, California, 12/13/1912; NPR-3, Teaport Dome, Wyoming, 4/30/1915; and NPR-4, on the North Slope of Alaska, a bit west of the Prudhoe Bay oil field, 2/27/1923. In addition, three naval oil shale reserves were also established by executive orders during the 1916-1924 period. However, with the enactment of the Defense Production Act of 1950, which provided the federal government with very broad powers to supply its defense needs, it was not necessary for the Navy to maintain its own separate wartime oil reserves.

Eventually, the Congress passed the Naval Petroleum Reserves Production Act of 1976 (P.L. 94-258) which transferred the administration of NPR-4 from the Department of Navy to the Department of Interior, effective 6/1/1977, and changed the reserve's name to the National Petroleum Reserve in Alaska (Title I, Sec. 102 and 103). There is no oil or gas production from this reserve.

In 1977, the Department of Energy Organization Act (P.L. 95-91; 8/4/1977) transferred the administration of NPR-1, 2 and 3 and the oil shale reserves, from the Department of Energy (Title III, Sec. 307), under whose jurisdiction they remain to this day. At NPR-1, the federal government has a 78 percent interest, or 90.3 thousand barrels per day (TBD) of crude, in gross production of 115.5 TBD (FY 1986). The other 22 percent of the unit is held by Chevron Corporation. At NPR-2, the government has only a relatively small royalty interest of 228 barrels per day (BD) derived from 1,807 bd of production from government leased properties and 3,294 bd gross from the entire Buena Vista Hills field (FY 1986). At NPR-3, the government has a 100 percent interest in crude production of 3,151 bd (FY 1986). In 1989, 96,000 barrels per day were produced from NPR-1. It is generally thought that all three reserves are producing at their MER.